Computer History Museum

Linear Technology Oral History Panel:
The Founding Years

with
Robert Dobkin and Robert Swanson

Moderated by:
David Laws

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David Laws: Today is March 31st, 2014, and this afternoon we are here at the Computer History Museum in Mountain View, and we're going to record a video oral history of two of the founders of Linear Technology Corporation and try to get some understanding as to how this quite extraordinary company managed to achieve what it has done over the last 30 years. The gentleman with me today on my left is Robert Dobkin, also known as Dobby, and is the vice president of technology, engineering-- what do you want as the formal title?

Robert "Bob" Dobkin: Chief Technical Officer.

Laws: On my right is Robert Swanson, better known to everybody as Bob Swanson. Bob is the founder and chairman of the board of Linear Technology.

Robert "Bob" Swanson: Executive chairman.

Laws: Executive chairman of the board, no longer has the CEO title.

Swanson: No longer have the CEO title.

Laws: I'd like to start off with a bit of background on each of you and how you found your way into this area of the industry, and how that led to the founding of Linear Technology. So, Bob Swanson, can you give a little background in terms of your family, where were you born, where were you educated, and what your interests were in those years?

Swanson: I grew up a little town call Wilmington, Massachusetts, which is about 18 miles north of Boston. College days for me were during the Sputnik crisis when everybody was encouraging you to be an engineer to catch up with the Russians. So I went off to school, first to a two-year technical school because I actually wanted to be a pilot. Nobody in my family went to college, and I didn't get any pressure to go, but I recognized that to be a pilot, you had to have at least two years of college.

I liked math and I liked science, so I went to a two-year technical school, and that was called Wentworth Institute of Technology; it is still very well known. When I finished that I took the test to go in the Navy, and there wasn't a slot for pilot training until December, and this was May. It's a long story, but my parents had bought me a new car, but I had to make the payments on it, and so in order to wait till December, I had to go get a job, and I stumbled onto this company called Transitron Electronics, which made transistors and diodes.

Now, I actually had a degree in industrial engineering, but I knew what a transistor was, which was a big deal in 1960. I had a one semester class in transistor physics and circuits, so I went in there and interviewed, stood in line with all the operators. I had a background in statistics. They hired me on the spot, and so that's where I started my career.

Laws: And about what year would that have been?

Swanson: Oh, 1960.

Laws: 1960.

Swanson: Yeah, yeah.

Laws: And Transitron was quite a leader in the industry in those days, I understand.

Swanson: Transitron had $60 million a year in sales, was the second biggest chip company in the world back in 1960, second only to TI. People ask me, well, how big was TI, and I can't recall, but they certainly weren't $1 billion. I'm guessing they were maybe $150 million. So the entire market for chips in diodes and transistors had to be less than $500 million in 1960.

Laws: So what did you do at Transitron?

Swanson: Well, as I said earlier, I wasn't a double E, but I understood statistics, and Transitron had just won a major contract with Lockheed to build a transistor for the Polaris missile program, and this was the beginning of statistical process control. Part of the requirement in the book from Lockheed was that you had to do a chi-square test. That's about it as fundamental in statistics as Ohm's Law is in engineering. Nobody knew what a chi-square test was-- not David Bakalar not Leo Bakalar not Nick DeWolf, the future founder of Teradyne, and so I said yeah, I know what that is, and they said, you're hired.

I had actually gotten another job offer at Polaroid, and if you grew up in Boston, Polaroid was the place to work. But the guy who would be my boss was on vacation, and so I couldn't report for two weeks. Well, I needed pay for two weeks, so I accepted the job, and I told them what was going on, and they said, well come work for us for a couple weeks. If what you do here is not interesting, then go work for Polaroid. Well, I stayed for two weeks, I stayed for three months, I gave up the idea of going into the Navy.

The first project I worked on was a PNP transistor, germanium transistor for the Polaris missile program, and again, my first job was basically to look at all the data on the development line for every run that was

built, and do tests of significance and so forth and so on. That only took, maybe, a couple of hours, maybe even less than that, so they said why don't we teach you how to actually make the measurements. So I'd sit down at [a Tektronix] 575 oscilloscope and other homemade equipment and I'd take the data, and even that didn't take more than four hours a day, so they said come out on the line, we're going to show you how we make these things.

So anyway, it's a long-winded answer to your question, but when that product was getting ready to go to production, they offered me the job as the production engineer, because by this time, I knew as much about how it was built as anybody.

Laws: Interesting beginning.

Swanson: Yeah

Laws: Not planned at all.

Swanson: So that automobile that my parents bought me that I had to make payments on probably saved my life, because I didn't go in the Navy and didn't wind up on some hillside in North Vietnam.

Laws: That's a great story. Dobby, tell me a little about your background. How did you get interested in the area and develop your skills?

Dobkin: I always liked electronics. I liked electronics as a kid. I started by taking things apart, and then I learned how to put them back together again. I did electronic projects, so I knew something about it. I went off to school in Boston, to MIT, and I was not a good student. I wanted to do electronics, so I spent a lot of time the library and not doing my homework, so I didn't do very well there.

Laws: What did you go to study at MIT?

Dobkin: I thought I'd keep electronics as a hobby, and I went to study metallurgy. Which actually has been very useful over the years. After two years I dropped out and went back to Philadelphia and got a job at GE Reentry Systems. I was in the Test Equipment Division, where we'd make test equipment for satellite pieces. I found GE had a great calibration lab, and back then, all the equipment had manuals with schematics and circuits in it, so I continued to study how circuits worked over that time period.

I stayed there for about, I guess it was about a year and a half, doing test equipment, which last time I went back was still in use, and I got recruited to work for a company up in Boston called Philbrick Nexus.

They made modular op amps, which is a little epoxy block with a few transistors in it, a very popular structure for doing circuits. The person who hired me in was Bob Pease, who's well known now in the industry. I don't know how well known he was there, but he was somewhat of a character-- very bright, very good at engineering.

I worked at Philbrick Nexus for a year. I was supposed to develop ICs for them, but -- they were part of Teledyne--and there was so much infighting between the different sections of the corporation that we couldn't get anything done. It was just horrible. So I got an offer from Bob Widlar at National Semiconductor. He is another well known IC expert. Well, back then, there was only one person who was really well known for doing analog ICs, that was Bob Widlar, and that was in 1969.

Laws: OK, so you moved on to National in '69?

Dobkin: Yes, so I moved-- I wrote to Widlar a couple of times, and he called me up and said, if you think you can do better than me, come on out here and show me. So I went out to National Semiconductor, and he retired about a year later, and I took over his group. So that's how I ended up in the semiconductor industry at a company that could really make semiconductors.

Laws: It's interesting neither of you went into the business intending to get into the semiconductor industry--

Swanson: As it turns out, we were quite lucky that we fell into it at the beginning of an industry that turned out to be so significant. But at the time, people were still talking about tubes and other electronic devices.

Dobkin: And they were making things out of discrete transistors. It took Widlar and National Semiconductor to teach the world that you could make high performance analog [circuits] in chips.

Laws: Sure.

Dobkin: And after a couple of years there, the highest performance analog circuits were in chips. So after that, people stopped trying to do it out of discretes and were working with chips.

Laws: So how did you get into analog? You went from Transitron to Fairchild

Swanson: In 1961, Transitron experienced the first recession in the chip business. Their sales fell from $60 to $38 million. The place was in turmoil. The Bakalar brothers really didn't know how to manage in

that kind of crisis. They treated engineers like they were a commodity. You probably know the story that they hired a group of engineers from England, a group from France, a group from the Netherlands, and they thought there was an endless supply. They would go over and hire them at European wages, bring them over, and-- so anyway, long and short of it was morale went to hell in a hand basket, and most of the senior people that I worked with like Pierre Lamond and Wilf Corrigan and so forth who were smarter than me, they left early.

But I hung on until 1963, when it was pretty clear to me that this is company had no great future. Luckily, I got a call from somebody at Fairchild, where a lot of other people had preceded me from Transitron. In fact, the San Rafael factory, in the early '60s, was referred to as Transitron West.

Laws: And that was San Rafael, California.

Swanson: San Rafael, California. So anyway, I went to work for them, and learned that-- and my job at Transitron was basically a quality kind of job, trying to make the product better, more reliable. And the way to do that, usually, was adding steps. When I got to Fairchild, they explained to me, this is a business, so we want you to make the product better, but we want you to make it better with less steps, not more. So I learned one of the first big lessons there.

I worked there for about four and a half years in various jobs. I think my first job was section head in quality control engineering, and then I wanted to be a plant manager, so Fred Bailek said "Well, you don't know anything about running a factory, and a good place to start would be production control." So I went in production control as a planner. I used my math skills, and pretty soon I was showing them how to predict the availability 12 weeks out, which they thought was amazing. I became production control manager, and then my last job there, I went back into operations and I ran one of their two groups. One was called Standard Diodes, and one was called Advanced Diodes, and I ran that group until I finally left to join National, which is something I wanted to do immediately when all those companies were born in '57. But because of an agreement between Fairchild--

Laws: You said '57, you meant '67.

Swanson: 67 excuse me, '67, between Fairchild and National, they agreed not to hire any more people. So I waited a year and then joined Fred Bialek in Danbury, Connecticut. So I worked at National for 14 years. I worked in Danbury to straighten out this mess that they had back there. I wanted to do a good job so I could get back to California. I lived in Tiburon. I went from Tiburon, California, to a place called Danbury, Connecticut.

Now I'm laughing, because most people think that Danbury, Connecticut, is this beautiful place, and it's not bad, but it wasn't Tiburon. So I worked real hard to get back to the West Coast, and I did a good job.

Instead, they offered me a job to go to Scotland to set up a factory, and set up another factory in Germany. In those days, there were two marketplaces-- EFTA and the Common Market, you probably know that the biggest country [in EFTA] was the UK, and the Scandinavian countries-- anyway, to make a long story short, I stayed there. There were a lot of jobs that I did, but basically, I set up the business for National running both factories, and then I think in 1971, moved from Scotland to Germany back to Scotland to build their first wafer fab, which is still in Scotland right now.

And after about six years, I actually came back to the U.S., and I was given the job to run the Analog Group, and I think I told you previously that I hardly knew an op amp from a voltage regulator. I had no idea why Pierre wanted me to run this group, and frankly, I didn't know if it was condolences or congratulations running this group. It was a flagship group. They made these really hot products, but some weeks they couldn't make them and some weeks they could. They had a bunch of very talented prima donnas, including guys like Dobkin, and so anyway, it turned out to be an interesting experience. So it was 1973 when I was given the job of running analog.

Laws: And that was all of National's analog?

Swanson: That was all of National's analog, all of it, yeah.

Laws: And the business then was--

Swanson: Business then, I think in '73, it probably was in excess of $100 million in sales, and there were actually three groups-- Advanced Linear Group that Bob [Dobkin] ran, Standard Linear Group where products got to be more mature, and a Consumer Linear Group, products aimed at the consumer business, which were things like audio amplifiers. And the way this thing worked is that Bob's group would generate these new products, and then you would move them into the Standard Group some years later. And basically what that meant is we would be willing to accept a lower margin in the Standard Group, and the Consumer made no margin, one of the other lessons I learned.

When I left in 1981 to start Linear, [the analog business at National] was a $250 million dollar company. I think I also told you earlier that, at the time, about 1981, normally we were the best in terms of technology. Whenever they did a survey, customers were asked "Who do you think of when you think of linear analog integrated circuits to buy from?" National was number one, PMI was number two, ADI was number three, and TI and Motorola were number three or four or four or five, I can't remember. But National's score was bigger than the next three guys combined. That's the kind of brand recognition they had, because of the kind of products that guys like Bob made.

But in 1979, Charlie Sporck bragged at one of these exempt dinners by 1979 we also could say we were the biggest in analog, biggest US company. I think we'd just passed Motorola at the time.

Dobkin: When I was at National, with Widlar I learned a lot besides just doing the circuits. It was important how to pick them, it was important how to how to test them, and how to present them to the customers. Because it wasn't by accident that National was the biggest. We presented the products, we backed up how it worked with lots of literature, lots of applications, and when a customer needed a part, he'd go to National, because the parts he got worked.

Laws: Easy analog--now there's another aspect that was important that I thought you were going to talk about. That was the synergy between process and design engineering and analog.

Dobkin: It was important because if you don't do the process right, you can end up with parts that are unreliable, don't meet spec. There's all those intangible aspects of analog products like noise, stability-- and if you don't get the process right, you start interfering with those, and the product may meet the spec on a high-speed tester, but when it gets in the customer's circuit, you get complaints.

Swanson: Yeah, even as the technical flyweight in the team, I observed that the analog engineers, the good ones, understood the silicon, understood it very, very well.

Laws: Did the silicon people understand the circuits, did they have to?

Swanson: Not necessarily, no.

Laws: It was up to the designer to really get into the depths of the silicon and help tweak the process?.

Dobkin: It was designer centric. In a lot of power products you can have this chip where one side of the chip is 50 degrees hotter than the other side, and there are components that have to match to better than a tenth of a degree for it to work right. So it's a matter of the physics, it's a matter of the assembly and it's a matter of understanding how to lay it out to make it work right.

Laws: And this was all learned on the job, because you certainly didn't learn it in college.

Dobkin: There were never any courses that went that far.

Laws: How do you go about figuring out a process like that? What's the approach to the challenge?

Dobkin: Sometimes it's trial and error, but most the time you know the problems that you're going to run into, and you think around them as you are doing it to get the part to work right.

Swanson: My observation was that, and kind of a joke, is that the ten-year designer was better than a five-year designer because he'd made more mistakes, so I think some of them must have been trial and error, and as long as he was good enough not to make that mistake again, he was now anointed senior designer.

Dobkin: Yeah, I've said that too. The older the analog designer, the better, because he's learned many years [worth] of mistakes not to make.

Swanson: So I had a lot of Eureka moments, and one of them was how you can't sit down at a computer and design one of these circuits-- you can't simulate it and so forth. So there was a lot of work done in layout, working with the silicon to get it right.

Dobkin: And a lot of measurements, because there's a lot of things that are not well characterized, especially back then. So you want to make something, but you have to go test some transistors and ICs first to see what you can find out to put in the new one.

Laws: Now would you be doing your own layouts, as well?

Dobkin: We had people that were specialists in layout, but the design engineer hovered over the layout every day, looking at different pieces. If he didn't look at it several times a day, he wasn't doing his job.

Laws: And so during this time, then, you were running the design group for Advanced Linear, is that right?

Dobkin: Yeah, this was while I was at National.

Laws: How many designers did you have at that point?

Dobkin: I had in my group, four designers, including Bob Pease at one time.

Swanson: So the organization was pretty interesting. You'd think way back then a $200 million business, $250 million, we had three different groups, as I said before. Each group had its own operations manager and its own design manager, and then a product manager ran the whole thing, and he had test and everything. Each of these groups had their own wafer fab. The only thing that was kind of shared was the sales force and assembly. So it was like they really taught us, maybe they didn't mean to, how to run a business.

Dobkin: It was-- and as part of that group, you had to get involved with anything that wrong, OK, it all came back down to all right, this part doesn't work right, who does it go to? You go to the design guys who have to decide is it the process, is it the circuit design, is it some other unknown problem showing up?

Laws: So during this time, Bob, you had the fab areas [reporting to you].

Swanson: Yeah.

Laws: Three by the sound of it.

Swanson: Three of them, yeah.

Laws: Three and each of those had a fab manager and a process engineering team--

Swanson: Yeah.

Laws: --sustaining engineering.

Swanson: Right, so the product manager, he was called the product line manager for each of these groups, had a fab manager, and he had a design manager. The fab manager was more than fab manager-- testing, product engineering, everybody was reported to him other than design. I think he was called the ops-- what did we call him, the operation manager? Yeah.

Dobkin: Yeah, he was Product line manager.

Swanson: Product line manager, yeah.

Laws: And so where was your focus, in terms of running the business? Was it new product design and definition, was it manufacturing, was a customer service-- there are so many things.

Swanson: Well, my background was manufacturing, so I tried to contribute in that area, but I had this Eureka moment maybe a year into the job, a year and half into the job, when the two lines that generated all of National's sales then was their TTL digital [logic] business, and the analog business. And I think, if I did $250 million in sales, a guy named Jim Smaha who ran the digital group--maybe they did $350 million. Our margin was much higher. And I remember Jim's job, he was making gates and flip-flops, like

everybody else. As far as I could tell, there was no difference between them, and his job was to figure out how to whittle away at cost to stay in the game.

And I realized what the Linear guys were doing-- they were designing better op amps, they were designing better regulators, they were designing brand-new functions, and cost was something you did a double-check on, but they were creating value at the top line. You know, an extra quarter, an extra $1 for the same piece of silicon that does something. Well, I liked this model way better, and so that was the day I realized if I ever started a company, it was going to be an analog company. Because by this time, I felt I knew it, and the second thing, if I ever do it, it's going to look like Advanced Linear.

Dobkin: And we were trying to make products that just pushed the state-of-the-art that people would buy, and it's frustrating in analog that you can come out with a great product, and it still takes three years before you get appreciable sales.

Laws: The whole design-in process you have to go through.

Dobkin: The process of getting the customer to design it in and buy it, so--

Laws: And for him to sell his equipment.

Dobkin: Yes.

Swanson: I remember one of the hot-shot devices that National was making in Advanced was the LM108, which was a super beta amplifier, and I don't know, we probably sold the military grade for $50 and the commercial grade for several dollars, but this is a product that some weeks they made them and some weeks they couldn't make them for various reasons.

Laws: And how do you go about solving a problem like that?

Swanson: Well, obviously it becomes a focus, so I think what I contributed is this notion that, OK well, some weeks we can make them, some weeks we can't. That's the business. It was like we need to figure out how to make them every week, and so we did, and obviously, the problems got solved. But this whole thing about these advanced circuits being so fidgety that some weeks you can make them, some weeks you can't-- I think maybe that's what Pierre had in mind when he put me in there, that I would try to bring some of that discipline to it. Because I certainly didn't give him any design tricks or any design solutions.

Dobkin: At that time, it took a full redesign of the circuit, while we were still in production, of course, and a redesign of the process, and then it ran like a hose.

Swanson: I probably got some praise for that.

Laws: So you've taken this business from $100 million to $250 million dollars, you were making lots of money, why did you change?

Swanson: I think it was Bob Noyce who answered the question this way-- frustration finally overcame loyalty. This was the dawn of the digital revolution, and while Charlie Sporck and senior management were very happy bragging about the analog business being an outstanding business, clearly, as far as they were concerned, the future was in digital, and analog was kind of a cash cow, something to brag about, something to depend on to generate cash. But everything about strategy-- it was dominated by we're going to be in the MOS business, we're going to make memory, we're going to make microprocessors.

And frankly, we were a little frustrated about that, but probably the real frustration came from the fact that the company started to get big, it started to embrace matrix management, which really meant that everybody was in charge of everything and nobody was responsible. So it got to be very difficult for me to run this flagship line, to get things done. I found myself spending half my day arguing with other people over turf wars and things like that. It became very political and very, very bureaucratic and there's lots of stories Bob and I could tell. But one day, I had a deal that just broke the camel's back. I said to Bob, we shared cubicles from together, and he asked me why I was frustrated, and I told him. And he said we ought to start our own company. That's the day it happened, yeah.

Dobkin: It was frustrating from an engineering level. OK, we have to make masks to make RCs? The mask group which was internal at the National plant just had a huge queue of digital things. We couldn't get our one mask in. We found our way around it-- you buy a bottle of wine and you give it to the guy who's running the line, your mask goes right through.

Swanson: I mean service groups-- it was never explained to service groups that you're here to service the guys that make the money. We had situations where Charlie said that everybody had a P&L, which is kind of a nice notion when you think about it at first glance. So guys in Singapore or guys in Malaysia who are building linear devices and gates and these little black things called DIPs, they would decide one day that "Why does analog have this coating over the die? Digital doesn't have it, the gates and flip-flops don't have it," so one day our yields went to zero, and we found out they'd removed it from the process. And when we argued with them, it was like, the digital guys can make their circuits work without this, you should figure out how to do it.

Laws: OK, so there's this level of frustration.

Dobkin: And it kept going up.

Swanson: Yeah, it kept going up.

Laws: And so one of you said we should start a company. Where do you go from there?

Swanson: Well, I think what happened was over that cubicle that day, Bob and I-- and I had decided before this, we're going to start a company. There were some really brilliant guys like Jim Solomon, who ran the Standard Linear Group. You probably know Jim, brilliant guy. But it was like if we're going to start a company, Bob Dobkin's the kind of guy who could design things that we can sell quickly, and they'll be uniquely different than doing digital speech recognition chips or whatever.

So we talked about it, and we realized we needed more than two of us, so we exposed the idea to Brian Hollins. He was [Bob's] counterpart running a factory; he was a really good fab guy, test guy, whatever. He was in. And then I guess he talked to Widlar, and Widlar decided for himself he should be in.

Dobkin: At that time, Widlar was not working full time. He was retired and contracting the sale of circuits to National on an individual basis.

Swanson: So there were four of us, and we said, well we need someone in sales and marketing, so we asked a guy named Brent Welling, who was the Advanced Linear marketing guy, because marketing worked for the product groups, too-- actually, they worked and reported to me, and there was one for each of these three groups that we described. And he had just been moved to microprocessor because he was a very, very good guy. We asked him would you be interested in coming to work for us back in analog, we're going to start a company, and he said yes. Anyway, this went on for three months.

Laws: This was what year?

Swanson: This was 1981, the spring of '81. And I will tell you that because it took us three or four months to have the courage to actually do this,the five of us would go and drink beer and shoot pool at my house in Saratoga and--

Dobkin: And discuss things.

Swanson: Yeah, and discuss things. And so Bob was going to design circuits, Brian was going to make them, Brent was going to sell them, and my job was to get the money. So I had lots of meetings with venture capitalists. This was a very scary time, because a company called Seeq was sued by Intel, and they sued not only them, they sued all the venture capitalists. So all of a sudden, the Kleiner Perkins of the world, they were getting a little touchy about being sued. They were being accused of basically raiding Silicon Valley companies to start their own companies.

So anyway, after about three months of talking this thing through--we couldn't write a plan, we-- I had already talked to a lawyer, and we knew it was going to hit the fan when we left.

Laws: So you didn't want to write the plan while you were still an employee?

Swanson: We were told not to write one, so I knew a lawyer at Wilson Sonsini. I talked to him, he gave us some advice-- all the things you could and couldn't do, and pretty much, we couldn't do anything. Don't have any meetings during business times, don't write anything down, and I said well, that kind of presents a challenge, I gotta go raise some money from some guys on Sand Hill Road, and I've never met any of them, and I can't tell them what we [plan to] do. And he said just tell them verbally, and I went "That's going to be a handicap."

Anyway, the long and the short of is that after playing pool and drinking beer for about three months, Brent Welling one night said, "Hey, Bob, are we going to actually start a company, or are we just going to drink beer and shoot pool?" And that kind of shook me, and it was like there I was a vice president, I was making good money, I had two kids getting ready to go to college. I was the youngest vice president at National, but I was frustrated, and like I usually do when I'm impetuous, I jump off the bridge and hope there's warm water below.

Anyway, so that's basically how it began. We got funding from four venture capitalists, very well-known. This was the days when good deals were shared. That ended shortly thereafter. They had Hambrecht and Quist, we had Mayfield. Mayfield brought in Sequoia, Don Valentines' company, who I was afraid to go to for fear that he would rat on me.

Laws: That's right, because he was close to National.

Swanson: Yeah, and then him and Hambrecht and Quist and brought in Kleiner Perkins, they were the four. And then after we did our deal, I'll come up for air here, two other people wanted in-- Sutter Hill and Technology Venture Investors. I didn't know at the time, but they're all really, really well known. And after a very short period of time, I realized that what a significant thing it is for Linear to say we've got all these people.

Laws: You had the cream of the crop there.

Swanson: Yeah, the cream of the crop.

Laws: How did you feel about this?

Dobkin: Well, I was not quite so wary, because I already knew that I could get a job if it didn't work out.

Swanson: They [National] tried very hard to separate us. I was the one who was going to be out of work.

Dobkin: And yeah, they really tried at National to separate us, to give us individual perks to stay. None of them made any sense.

Swanson: I had my fingers and toes crossed. I knew what was going on.

Dobkin: There was no way I was going to stay, there was no plus to it. And even when I was leaving, Pierre kind of intimated he would like to be part of the company.

Swanson: Well, he did more than that. It turns out that John Finch was my direct boss at that time. Sporck was in Asia and Lamond was the most senior guy, so Lamond tried to talk us all out of it. I remember I didn't get the feeling that he was trying that hard, and so anyway, they walked us out on a Thursday. I think we handed in our resignation on a Tuesday, and they walked us out. I was told by Valentine to get out of town. That's another good story-- get out of town because it's going to hit the fan, and I don't want you talking to the press or anybody like that, you're just going to infuriate the situation.

So I get ready to go to Hawaii on Monday morning, and Sunday night I got a call from Brian Hollins saying hey, Pierre just called me. I thought about it, and I said he might be interested in joining us, and so Brian met with him Sunday night one-on-one and called me and said, yeah, he'd like to be the CEO.

Laws: No way.

Swanson: I'm going to be the CEO, and so anyway, I think Pierre did talk-- he called me and said look, I think I can help you. And look, I'm getting out of here, I've worked with him for years and I liked him and he was very good to me, but I want to try to do this my way.

Laws: I understand.

Swanson: I'm 42 years old, I'm kind of an old guy to start a company, and working for you will just be like working at National. I want to try this on my own. The good news was that all the founders said we want to do this with Bob.

Laws: Good for you.

Swanson: But he was a pretty senior dude at the time.

Laws: And then he went on to Sequoia [Capital, the VC company] eventually.

Swanson: Yeah, he went to Sequoia.

Dobkin: And at that time, in the years preceding that, I'd had offers from other start-ups to go start a company. When you start a company, it's a team, all right, and we had a team when we started Linear that I trusted. I didn't have to worry about the process, I didn't have to worry about running the company, I just had to worry about being able to make products and get them sold. Other companies I would have had to worry about that, and I had no experience working for Pierre. I'd been working for Bob, I wanted to work for Bob. We had a working relationship.

Laws: So I have here a copy of Don Hoeffler's [Microelectronics News, August 1, 1981] newsletter. Somewhere buried down here, he was onto you pretty fast.

Swanson: He was, he was onto us fast, so--

Laws: Here "Linear group quits National,"

Swanson: Yeah, here's the original business plan. Some of those are in here. But one of kind of cute story, wasn't so cute at the time-- I told you Don said get out of town and stay out of town, don't talk to anybody. So I go to Hawaii to lay low, and the next thing you know, I get a call from Don about three days later, and he'd yelling at me on the phone. He wanted to be on the board, but he wasn't, but he was just like a board member, and he's saying you know what your guys did last night? I said, no, I have no idea, I'm in Hawaii like you told me. He said they had an interview with Business Week and Dobkin said I just want to get rich like everybody else. And I-- oh, no, how could you guys do this to me? So we don't have money yet, we had no money, and so I thought well if Don pulls out, we might have a problem, because he's well respected as being probably the only guy in the venture capital team that understood the business. And obviously it all worked out, but that was the first "Oh no" moment.

Laws: So how much did you raise?

Swanson: We raised-- we decided we needed $15 million, which turned out to be a pretty good number, and so we negotiated with Hambrecht and Quist and Mayfield. And I'm pretty conservative, so I sort of wanted to get my hands on the $15 million, and that was a lot of money, but if you think about in today's terms, a wafer fab, a whole team, designers, so forth-- and it turned out that we did our numbers pretty well.

And I had a conversation with Don Valentine, and he explained, he said there's a thing called stage financing. I said what's that mean? He said well, you don't have to take all the money up front. I don't know about that-- maybe I should get the money up front. He said you could get $5 million up front at $1 say, and then you could do some stuff later and get the other $5 million at $3, and maybe the last $5 million at $5. Well, what do you have to do to go from $1 to $3? He said, you know, put a team together. And I went, that's all? We can do that, what do you have to do to get to the last part? And he said, well, you have [to make] a couple of circuits and build a fab, and I said, that's what we do every day. So we did stage financing, and we raised $4.5 million.

Laws: So the first tranche was $4.5 million?

Swanson: Yeah, it was $5 million, but the founders had to put up $500,000. None of us had $500,000, so we signed an IOU and did $4.5 million. Then I had to go get somebody to build a factory for me for $7 million that had a tank farm a wafer fab. That was $2 million beyond any real estate deal if we crashed. I didn't understand why some of them wanted stock options, just like the venture capitalists, and we didn't want to do that.

Anyway, the long and the short of it is that people like Peery & Arrillaga told us to get lost. Sobrato said I'll build you a factory, but you've got to give me stock just like the venture capitalists, which when I think about it now was quite reasonable of him. Anyway, a guy named Joe Callahan from Callahan <mark>Pentz,</mark> because of personal connections with venture capitalists, he built us a factory on his nickel without one share of stock.

Then I had to get $10 million to put equipment in the factory, and somebody said there's this thing called a lease line. I said OK, so now these guys are designing circuits, I'm out trying to be a CFO, I have no CFO, and so the deal was that I needed $10 million, and I went to every bank with my business plan-- yeah, I've heard about you guys, a heck of a power group. They said we'll lend you the $10 million, but you've got to collateralize it with ten. Well, I only have $4.5 million, it has to pay salaries and stuff, and so I basically went to about 20 different banks and they all told me the same thing-- great company, you guys have got a great future, but it's one for one.

So just as I was suffering from despair, the guy, Glenn Mueller, who was the Mayfield guy, really great guy, just like he introduced me to Joe Callahan the developer, he introduced me to a guy named Bob Dee from Greyhound Financial. I didn't even know there was a Greyhound Financial. I didn't realize they were bigger than the bus company, but that was their business. He came to see me, saw the business plan, met the team, and said I'll give you the $10 million with only a $2 million collateral deposit, and I went, well, that's a whole lot better, but I don't have that $2 million either. And he said, I'll tell you what, I'll buy $2 million worth of your stock at $3 a share. This took place five or six months after our first round.

So here it was, our second round, at $3 a share. Bob Dee from Greyhound was going to buy $2 million worth of stock to give me the $2 million for the collateral deposit. As it turns out, I went and got a very famous Hong Kong, Chinese, company to give me a letter of credit for the $2 million for some warrants at five so I could free up the $2 million and spent it also.

Laws: Had to learn a lot in a short time.

Swanson: Yeah, in fact, I kid our CFO that I was the CFO for the first 12 months, because we didn't need a CFO.

Laws: Sure.

Swanson: And I tell him I made better deals on leased lines and so forth and so on. And then we did another round just before we went public at $5 a share. It was called the mezzanine round-- that looked like a regular private offering, lots of people buying-- the same people who would buy our stock in the IPO bought at $5. That was a $5 million deal, and I was learning lots of things.

We went out to Europe, to Scotland, to every place and did our business plan. Everybody said it's too expensive, but we want to buy more of it. I still didn't understand a lot of this, and so by the time we get back to Boston-- we started in California, Boston was the last stop-- I talked to a fellow at H and Q and I was feeling a little depressed because everybody was telling me it's too expensive, they were telling him why can't they buy more?

Laws: This was the mezzanine round now?

Swanson: It was the mezzanine round, the $5 round. So we got to Boston, this guy Mike McCaffrey, who you may know, a brilliant guy, said Bob, no, it's going great. This is a private offering; we want to get $5 million. There's already $13 million circled. And I said what does that mean circled? He said, they're committed to $13 million. I went whoa, we were looking for $5 million. So he said look, you can't raise the price in a private round, the cosmetics should be good if we cut people back to $8 million so you get 50%

more than you were asking for and you've cut back-- he said that will have the right cosmetics. I went, oh, OK.

All of a sudden, I had $8 million. And so if you added it all up, it was like $17 million. We broke even from a cash point of view with a full fab and a bunch of products at $15.5 million.

Laws: Quite a story!

Swanson: Yeah.

Dobkin: Our beginning philosophy on products was we had to make products that would differentiate us in the marketplace. We ought to have something in our products that was appealing to the customers. Well, to get business quickly, we started off doing second sourcing, but they weren't exact second sourcing. Whatever the prime parameters were of the parts, we added trimming to everything we made, which was different from other semiconductor companies, so that the products that we made were right on the tightest specs that you could get--

Laws: By adding trimming, you mean you were trimming the components on the wafer?

Dobkin: We were trimming components on the wafer.

Laws: To get more precision in the design.

Dobkin: Yes, to improve the precision compared to the standard products that were out there. So there are sockets out there where people were using parts, and they probably had to trim up the system. If they put our parts in, they didn't have to go through any trim system of their own, so we are able to make parts that worked like the original ones, but better, and along the way, we aimed our fab to making highly reliable parts. We'd burn in our parts at 150 degrees C. After we've qualified them, we continued to burn in parts at 150 for a year to see what kind of failure rates we had-- they were extremely low.

Laws: But you didn't burn in parts that you were shipping?

Dobkin: Not when we're shipping.

Swanson: Unless they were mil grade.

Dobkin: Yeah, military grade parts got a burn-in.

Swanson: So that was an important part of our strategy, and so one of the side stories was, as I told you, Intel started suing the venture capitalists, and we met all the venture capitalists, including Perkins, and he said, you guys are going to get sued, you guys should forget that second source strategy, which, of course, was going to bring us income early, and just do proprietary stuff. I explained to him, well, you know, instead of having sales in a year and a half, two years, it might take three or four. He said, no problem, we'll just give you more money.

Now, I understood the stage financing part, and I went, I don't think I want to do that. So anyway, he definitely said you guys are going to get sued, which, of course, we did by National. In fact, we were sued for seven years, our first seven years of existence, but that was a critical decision to do second source products, help the existing suppliers. We clearly helped them service the market that they created with better products and then, I would say, within three or four years the vast majority of our sales were sole-source, unique products. But that first $6 million, $7 million a quarter came from better [LM]117s better [LM]108s.

Laws: A little bit like what AMD did in digital circuits.

Swanson: Exactly,

Laws: [MIL Standard] 883-for-free, to add something to make it more appealing.

Dobkin: Exactly. We structured the company so that all the new products had trimming, all the test systems had built-in trimming capability, which was not inherent in the test systems at the time, so that when we had the products that needed to be trimmed, we could set it up for trimming everything.

Swanson: I remember you did something else that at the time that I didn't fully appreciate, but a lot of data sheets were unclear as to whether this parameter was tested at temperature, and Bob insisted that we are going to put a red dot on all those parameters that have [been] tested over temperature. The other thing we did is, in the analog area, it's almost impossible to actually capture all possible specifications of analog circuits, you know, every corner. You do all the obvious ones, and so forth, but some of them, well, one of things that Linear did is any time there was a typical application, Bob made sure the guys actually bread-boarded it and made sure it worked. It wasn't just on paper. You do this typical application, you use these components it's going to work just like we say.

Dobkin: It's the theory of minimum of phone calls. You make a million parts, and unless they all work right, you get a million phone calls.

Swanson: After five, six, seven, eight years, with, this kind of strategy, people were talking about [you] get the best data sheets, you get the best app notes, and you get the most credible data sheets. When we look at your data sheet, we can believe you. Characteristic curves, we know you actually plotted them, they're real, and after five, six, seven, eight years, you realize how important that is for people.

Laws: To trust {Linear for] the next project--

Swanson: Exactly.

Laws: So once you'd started the company. Did you build the very first wafers, or did you have those fabbed outside somewhere?

Swanson: Ah, that's a good story, too.

Dobkin: Well, when we first started, we got a small place that was good for engineering and for offices, and as soon as we had the money, we started building our wafer fab. And our first wafer fab was over in Milpitas, and it actually got done 14 months after we started, we got our first wafer out. But meanwhile, we were making all these mask sets, they're changed, you need to see if they're going to work. There was a company that was making ICs down in Florida called MCE. [Micro Circuit Engineering, West Palm Beach]

Swanson: I remember the guy, Otto Hibbe.

Dobkin: He's a guy that talked very fast, but he had a wafer fab, so we paid for him to make wafers so we could check out our parts. We tried his wafers, we tried his parts, we were not happy with the reliability. We just used his parts to do experiments and debug our parts, never for any production, but [when] we got our parts out of our fab, we had mask sets that were clean, ready to go into production. We had the test systems ready, we ready to go ahead.

Swanson: And in 1981, there were no bipolar foundries and I'm guessing 95% of the sales-- by the way, the market was $2 billion total in 1981. Now it's like $45 billion, and I'd say 95% of that was bipolar, lots of special bipolar. The only people that had a fab like we needed were National and ADI and PMI, and they weren't going to help us. So we had to have our own fab. It was kind of a godsend, in a way, that we ran into this guy. A lot of people called us, and Otto Hibbe called us, and I didn't know him before. He offered his fab. He had processes, super beta processes, supposedly, and so forth. We were actually going to launch the company on his fab, because it was up and running. That was part of our original plan, but stuff started failing in life tests, and we looked at and figured out why. And we said we could spend a lot of time fixing his fab, but that put us back maybe a whole quarter, until our fab was up and running.

Laws: And Brian Hollins was responsible for building the fab, for bringing it up?

Swanson: Yeah.

Laws: You said 14 months after you'd started, you had your first wafers coming out.

Swanson: The first wafer is still on my desk, and it was presented to me in December of 1982. By the way, it wasn't passivated but it was patterned. It was a Christmas present. That was about 15 months, yeah.

Laws: So how did Brent go about selling this new company stuff that nobody knew? —[He used] reps, I presume, or did he do direct sales?

Swanson: Yeah, so we started out looking for stocking reps--I can't remember exactly the time frame, because Brent didn't last very long with us. We had a west coast sales manager and an east coast sales manager, stocking reps around the country, in every city, and also we made the terrible mistake of giving Arrow [Electonics, Inc.] exclusivity. That was a terrible mistake because it was nonsense for a company with six, seven products to give exclusivity to Arrow. Top management saw a good future, but it was years off, and so pretty soon our aggravation level at the sales level exceeded any good rewards, so they fired us. Interesting that they are our exclusive distributor again, but yeah, it was it was a group of stocking reps.

Laws: There a big training challenge there?

Swanson: Yeah, there was, and again, I think what happened was we had products that had to be sold on some kind of feature, something better than what's [already] out there, and stocking reps who were selling nine different lines, [those were] the days of dropping off a data sheet and a sample. We quickly realized that didn't work. But anyway, we had no choice-- we couldn't afford our own sales force. I would say we got to maybe $150 million before we had our first direct sales force. Now, we went from two guys to four guys to six area managers and so forth, but no direct sales people, per se.

Laws: They were all managing [the sales] reps?

Swanson: All managers, yeah.

Dobkin: We had field application engineers, and we had those pretty early, and they would go into customers and actually help the customers design.

Laws: And who did they report to?

Swanson: They reported to sales, to sales management, yeah. So I think back to our first sales manager in Taiwan, our first sales manager in France-- they were FAEs that worked for one of our distributors. So was very much a technical [sell] -- even in those days, and our products today are, like, 50 times more complicated, 10 or 15 times more integrated. OK, we've got a product that has a composite score better than Maxim's or ADI's. They have some things better, we have some things better. Our sales guy had to find the application where the things that we do better meant something, and that's all we were looking for, so he had to know our products better than the average salesman needed to know his products.

Laws: Which is a challenge when you're working with a rep who the better job he does, the bigger he makes in sales, the sooner he loses the line.

Swanson: That's exactly right. The reps knew, first of all, working on a project that would be three years out, we didn't even want to do that, but we had to allocate some time to do that. They weren't interested in doing that, and you're right, they had this fear by the time we get to be $20 million or $30 million worth of their business, it's time for us to go direct, which is exactly what happened.

Dobkin: Back in the early days, too, we didn't have a lot of applications people. The design engineering group did the applications [support] of all our parts and they went out to visit customers. The customers like being able to talk to the guy who actually designed the part, and the guys from the factory liked talking to customers. They could see the problems and see what to do for a better part next time. We had seminars, too.

Swanson: Yeah, so that's another unique thing. First of all, everybody at the company the first three or four years was a salesman. Since technical sales were so important, the designers spent a lot of their time before the products were finished, after the product was finished checking to see did we hit the bulls eye, didn't we. Does the next product have to have something different? But what I recognized is that a customer sees four five of us from sales, and then he starts to get introduced over a period of a year to all these gurus, and I could see them saying gee, you've got a lot of really smart people working for your company. And so the more they went out, the better impression they made about this little company called Linear Technology.

Laws: How big was the design group over the first couple of years, Bob? You and Bob Widlar and a couple of others?

Dobkin: No, eight people, nine people, I think.

Laws: OK.

Swanson: Yeah, I would say by the time we went public, you probably had a dozen and a half designers.

Dobkin: Yeah, I probably had--

Swanson: Today, we have about 275, almost-- those are circuit designers, surrounded by teams of support people.

Laws: When you went public --

Swanson: We went public in 1986.

Laws: So '86, after five years you got about a dozen designers?

Swanson: Oh, we might have had--

Dobkin: Twenty.

Swanson: Maybe a couple of dozen by then.

Laws: And this was the time when you had the "Gurus" [advertising] campaign?

Dobkin: The gurus actually started earlier.

Swanson: Before that, yeah.

Dobkin: Yeah, the gurus-- back when we first started, we wanted to start getting known. We didn't have a lot to sell, so we started selling the engineers, and we came out with the first ad that was the Gurus ad.

Laws: They were five of your key designers, including yourself? [Refers to a copy of an advertisement]

Dobkin: Yeah, five including myself.

Laws: For the sake of people who are going to see this in the future, who are these gurus? Can you give me their names?

Dobkin: Sure, this is me, I think I look a little different now. Carl Nelson, George Erdi, Bob Widlar, and Tom Redford.

Laws: And where did they come from?

Swanson: National and PMI.

Dobkin: National and PMI, yeah, and Bob Widlar was independent at the time. And they were known in the industry for products they had previously made.

Swanson: I would say for the first ten years, Linear's persona wasn't the house that Bob Swanson built-- it was the company that Jim Williams worked for, the company that Dobkin worked for.

Laws: Now Jim [Williams] hadn't joined the company at that time?

Dobkin: No, Jim joined later, he was in applications.

Laws: How did you hire these people? Did they come knocking on your door, or did you have to go sell them on why they should move?

Dobkin: They came knocking on our door.

Laws: OK.

Swanson: When I came back from that trip to Hawaii that Valentine scared the heck out of me, like maybe I've blown it, you guys had this interview with Business Week which is a typical hit piece that they do, I get home and I must have had 50 or 60 voice mails on my telephone. There were all kinds of people that worked for us at National, really good people, all wanted to come join us, and it was like I don't care anymore that Valentine's mad at me.

Now George Erdi is a great story. I was at a National sales meeting, and some of the sales guys were complaining about we need to put out more new products and so forth, and I was saying come on, we've got the two best designers, who are Widlar and Dobkin, what are you talking about? And they said, well,

there's a guy over at PMI who some people would disagree maybe you've got the best designers." What's that guy's name?" It's George Erdi. I didn't think anything of it.

A year later, when we started Linear, before we raised the money, just when it was announced in of these advance pieces, I got a call from George Erdi. Had I not heard the story from the salesman, I would have probably blown him off. I didn't know who he was. You guys all knew who he was, but I didn't. But I could tell that four or five really good, well-known designers in analog was the difference between a company with success and a company that might not make it. So we worked hard to get him on board.

Dobkin: And he was very productive and he came out with a lot of very good circuits.

Laws: These [engineers] were prima donnas?

Swanson: Oh, yeah, they were all prima donnas.

Laws: So how do you manage them?

Dobkin: They all, except for Widlar, they all wanted to make a great company, because they knew that that's what their reward would come from. There was really no trouble managing them. It was OK, what are we going to make next? It was really very easy. In terms of what I did, I'd go look at everybody's circuit. They didn't mind me looking over their shoulder. If I saw mistakes or problems or had suggestions, it got incorporated into the circuit, the circuit came out better. There was no problem. Widlar was working for himself.

Swanson: It was easier for him that it was for me. I was the guy that was counting money, and we were getting close to running out of it, so--

Laws: Yeah, you must have been paying these guys pretty well.

Swanson: Well, none of them were overpaid. They all took pay cuts to join us, but they were expensive. When this company started, we had this great business plan. We spent exactly like we said. The only thing that didn't happen on time was sales, and so there was one period of time just before we did that third round of financing where I had $1.8 million in the bank and we were going through, I think, $300,000 or $400,000 a week. No, it wasn't that much, it was like maybe $150,000, $200,000 a week, and I went whoa, that doesn't go into $1.8 million very many times.

I already had it in the back of my head that when you decide that you need money, even if you're a very good company, it might take six months, actually, before you see the check, so that's when I scrambled to go out and get the money. People took pay cuts and did other things to-- as luck would have it, as soon as we got the money, our sales jumped up $1 million a quarter, all of a sudden, we broke even, but--

Laws: All planned, of course.

Swanson: Yeah, but I'm saying these guys were all really good engineers, all committed to the company, but sometimes I had to explain to them why I couldn't buy that extra oscilloscope they wanted.

Laws: Sure.

Dobkin: One of the nice things about analog, the products we made back then, when we started, they're all for sale now, and they still sell in volume.

Laws: How did you choose the products? What was the decision process you went through? Did the guys come up and say I want to build one of these? Was there a justification process they had to go through?

Swanson: Not early on.

Dobkin: Not early on. It was mostly talk about a product, "is this a good idea, what kind of features do we want to put in it?" Its all talking over the water cooler or next to each other and come up with-- OK, we ought to go make one of those, and we went and made it.

Swanson: I mean we knew the sockets, because a lot of those sockets we created at National, and these guys knew how to make them better. We started the company-- you know, there's 50 companies out there in the chip business, digital's the wave of the future, analog is last year's technology, how are we going to compete? And we got together and said, look, we need to do something better than everybody else. Anybody know what we can do better than everybody else? And the answer was yeah, we know how to make even better precision op amps than even PMI can make or ADI. We can make better voltage regulators than National, who's the leader. So let's start there.

And our goal was so we could say these are the best products, nobody else can make them as well as we can, they're the best specs, so forth and so on. But as time went on, we realized we had to spread this specialist kind of reputation to make all analog products, because here's this finite, relatively small analog market, and we're starting out with a little piece of it, and on top of that, we're saying it's only high

performance analog we do. So we had to spread, we had to be a mile wide and a foot deep. That was the strategy how we did this.

Laws: What markets were most of your customers in, was it military or--?

Swanson: Well, in the beginning-- we were pretty flexible at moving from market to market, but this was the early '80s, during the Reagan days, and military was in a buildup. And what we discovered early on was that the military didn't care if you were a start-up. As a matter of fact, they liked the idea of start-ups because the big companies were preoccupied serving the commercial businesses. They felt like every time there was a boom business, they didn't get any support from anybody.

So we told them, look, we need customers, we can make these products. We had to do a lot of organizational and process kinds of structures so that we could satisfy quality and reliability and all those things, but we found the military customers to be very receptive to us. We gave them a lot of attention they weren't getting from the big guys, and so we were $100 million dollars, $40 million of that was military. That was our biggest market segment. Then we moved to industrial, then we moved to the PC era, we moved to the the communication area, and now [we're] in the automotive and industrial era.

Laws: How well did you think about moving? Did you drift into these areas, or did you say hey--

Dobkin: Some of them were strategic. Early on, strategically, we said analog circuits are going down from plus or minus 15 volts to five volts, let's make sure everything we make works on five volts, which was a good decision.

Laws: So CMOS was--

Dobkin: CMOS came later, but there's a lot of things you can do in CMOS you can't do with bipolar. We needed CMOS, so we put CMOS in.

Swanson: There were a lot of fads, everything from microprocessors that are going to do things that eliminate the need for analog and DSP [Digital Signal Processing] machines came along. And then the digital guys, by this time, made things called ASICs, and they were going to put analog on the digital chips and put us out of business. Every time the investor community heard about this, it was Panicsville for them, so we had to spend hours and hours and days and days convincing them what VLSI and what LSI Logic are going to add for analog is that cheap stuff that we never did and aren't doing, and the stuff that we do, they can't do. But you'd tell them ten times before they'd finally start believing you.

Dobkin: There were companies that said they're going to make analog ASICs who are no longer around, but at the time they got money [because] somebody believed them.

Swanson: But you asked about the process. We've told the story about Linear many times, and there are some secret sauce things that we do. One of them is every Wednesday afternoon, most every Wednesday afternoon, at 3 o'clock, designers present a product for approval. Now, they may have been working on it for months and getting all their I's dotted and T's crossed, and we have now 13 design centers around the world, so it doesn't matter where they are, it gets called in. And in this meeting is usually myself, when I was CEO, , the CTO, test engineers, other designers, process people, and the designer has to put up his product and say this is what this product is, this is what it does, this is the market it's after, these are the features that are going to make it better and going to make it worth this, and this is what I think it's going to cost. Basically people take shots at it and so forth and so on, and what markets it's been aimed at-- nobody would think we're going to build a product for a consumer anymore.

Dobkin: We talk about what we think that products going to sell for.

Swanson: Yeah, what that product's going to sell for.

Dobkin: If it fits into our product lines and our--

Laws: You have quite a formalized process.

Swanson: Very formal-- then it gets approved. Now, in the old days, it used to be five quarters later, seven quarters. Now it's sometimes 20 quarters later.

Laws: Before you start to see some--

Swanson: Before the product is RPLd [placed on the Released Product List], before it's finished, because they're getting so complicated. So we're making five and seven year bets now. So basically, this product that was introduced at a Wednesday meeting, four years later, now we have another institutional meeting called-- it happens every Friday morning at 10 o'clock, and it's a pricing meeting. And this is where a product marketing engineer does this detailed analysis of this product that was launched one, two, three, four years ago.

And we look at the assumption-- is there any competition now that didn't exist then? The things that we were shooting for that made it a better product, does that still exist, is that still true? Has the market changed? Is the thing still worth what we thought it was worth? And there's a detailed analysis of this

product versus the competition-- why it's different, why it's better. It's called a product pricing strategy summary. It gets into a document that goes to everybody in the field. That's another important part of how we have institutionalized this innovation process.

Laws: So you evolved into this since you realized it was necessary to have more control over designers deciding to do something--

Swanson: Well, in the beginning, it was verbal. Look, we don't sell our products based on some multiple of cost. We're making products, and our first cultural thing was what is this product worth? I know what it costs, but what is it worth? Don't just mark the cost up two times, three times, four times, five times-- what is it worth? Oh, well, I think it's worth $2. Why is it worth $2? Because it replaces something worth $3. OK, good. So that's how we started. That's part of the culture of the company.

Laws: In terms of culture, there's obviously something you've developed over the years, and hiring is a very important part of how you build a culture that works. What was the hiring process in designers, Bob? After you got your gurus, there are only so many gurus you can hire.

Dobkin: The gurus all had 15, 20 years experience, and they knew what products would sell in their areas. Then we started hiring people who weren't gurus because we needed a lot more people. They'd work with one of the more experienced people to pick products. How did we pick them? We knew they had to be able to design. We came up with a bunch of questions, and everybody had their own favorites that we gave them, and they had to solve circuit problems on the board or come up with answers on the board, or we had to see how they could think on their feet. That was one piece of it. The other piece of it, we have to look at how we thought they fit in. One of the things that we don't have is we don't have small kingdoms within Linear, and even now, we don't have small kingdoms. We picked people who wanted to work for the company to be successful. That was a big part of it.

Swanson: I think you heard about this book that was written, *The Company That No One Leaves*, and I think the guy did a good job of capturing that we have a culture that's not bureaucratic, it's not political-- it's an engineering-driven culture. So engineers come to Linear-- well, first they come and they stay, but even new guys come and quickly realize this is the place where engineers are given lots of freedom and lots of respect, little or no bureaucracy, little or no politics, and it's kind of an environment where all we care about is what are you working on and did you solve the problem?

Dobkin: And when is it going to get done? We had our board [of directors] into a meeting at Linear, and they were introduced to some of the engineers, and the engineers would stand up and give their name and say how long they'd been at Linear, and they're talking 15, 18, 20 years. The board was impressed with how long people stayed at Linear.

Swanson: These are the people that work under the general managers. These are kind of the senior engineering section heads that pull together everything that's happening in the 13 designs centers. Because Milpitas is still home base. Every time I do something like this, the board says well, you have a lot of smart people, Bob, and I get credit for it. But I was impressed-- they'd get up in they'd say I went to Cal Tech, I went to MIT, I went to Virginia Tech, I went to Berkeley, I went to Stanford, got a master's, got a PHD, I just got out of school 14 years ago from MIT with a PHD, and I've worked at Linear for 14 years. I went to Virginia Tech, I have a PHD, I've been out of school for 12 years, and I've worked for Linear for 12 years.

Laws: Impressive.

Swanson: Yeah, it really is.

Laws: So these 13 design centers, where are they? How many in the U.S., how many overseas?

Swanson: I think all but two are in the U.S., and--

Dobkin: Three, we've got China.

Swanson: Oh, yeah, China, that's right, so we have China, Singapore, and Munich. But our first design center is, I think a good story how Linear-- we had our first design center in Boston, you might say think, well, that's because ADI is there. That's not a bad reason, but that wasn't the reason it was there. We had a guy named Sam Nork who was a really, really good engineer. He was a product engineer, kind of a senior product engineer, and he was married to a young lady who was also an engineer. They both came from ADI to the west coast. She worked at National, he worked at Linear.

And one day, he informed me that he was going home, going back to Boston. That's where he was going to have children, the wife wants to raise children in New England. I'm from Boston, I understood that, but I hated to have them leave. Well we don't need a product engineer in Boston, but we were talking about a design center, and I asked Bob, hey, do you think Sam could be a design manager, and he said yeah, I think he could be. So we set up a design center—Sam Nork set it up. He wasn't a designer before. He runs a design center now with over 100 designers.

Laws: Wow.

Swanson: Yeah, and then we have one in Vermont, we have one in New Hampshire, we have one in North Carolina, there's one in Phoenix, one in Dallas, one in Santa Barbara, one in Grass Valley. We'll go anyplace-- we'll go to the moon if we can find six or seven really good analog guys.

Laws: This is driven by where the people are--

Swanson: Yeah, absolutely, yeah.

Laws: How do you manage all these design centers? They report to you?

Dobkin: No, they don't. We have one manager that runs all the design centers. But again, the groups of people that join the design center are still the type of people that want to work in an environment where they can do engineering, they don't have politics, they're respected for what they do, and they join Linear. You just have to give them a project, and you don't have to do a lot of managing after that.

Swanson: I think we've done-- I've actually bragged about IT -- I think we've done this remote design center thing very well. So they're like a resource to the general managers, and while there's one senior guy who all the design center managers report to, the working designers get their assignments from the GMs. So some of them are involved what we call D Power, some are involved with S Power, some just work for Mixed Signal. So basically, they take their product directions from the group, but all the administrative work and the reviews and so forth, and the person that the design center manager reports to is this central remote design center manager. So they're very much tied into taking direction and working on projects that the GMs have decided is part of their strategic goal.

Dobkin: A lot of the people in the remote design centers spend a lot of time back in Milpitas working with the engineers here. And as far as culture goes, cultures are very similar, because we have the same culture. People don't leave the design centers, either.

Swanson: Yeah, so we've done that very well. In the early days when people would say hey, you guys in your forties are going to be old some day, what are you doing to back it up? We'll worry about that later. After about 10 years, we realized we couldn't hire as many designers that we could afford and needed in Silicon Valley. Wow, everybody doesn't want to live in Silicon Valley, so we started to go where there were pools of analog talent, and we realized five or six good guys who can attract another five or six good guys, that's enough people to justify a design center. That's a lot of critical mass, in analog. We've done that, and we haven't lost control of it. We also visit these design centers every quarter with senior people who basically keep the communications really well.

Laws: Are there any markets you've gone into along the way and you decided are not where you wanted to be, and you had to back away from?

Dobkin: Sure.

Swanson: Yeah, yeah, so we actually did an annual report way back showing how we moved from military being the biggest, to the industrial market being the biggest, to, the era of the PC, to the era of communications, the networking Internet, and automotive. After the dot com bubble burst, we got to $1 billion in run rate, and overnight, it fell in half, so we were deeply involved in the PC, involved in the Internet tech. That was the days when you had to convince people that even though our name isn't Linear.com, the nuts and bolts of the Internet is the kind of stuff we make. We had a market cap of $23 billion dollars. It was crazy. We thought it was crazy, but we thought it was going to last forever.

Anyway, the long way to answer your story is that when our sales fell in half and we had to do a lot of significant things, even though we still remained healthy, as the world came back up again, and sales started to come off that $500 million to $600 million, to $700 million, we found ourselves involved in a lot of consumer stuff. The beginning of not smart phones, but featured phones with two displays and cameras and stuff like that, in iPods and MP3 players, those kinds of things. And we went, hey, wait a minute, what are we doing in this business? And it was like somebody tried to convince me, and they did, initially, that there's a new consumer era, it's called high-end consumer, which I later decided and confirmed is an oxymoron, there's no such thing as a high-end consumer. Anyway, we got to do about $300 million in this business.

Laws: Out of your $1 billion.

Swanson: Out of our $1 billion, yeah, as we climbed back up for $1 billion. By 2005, we were back up to $1 billion, but 30% of it was a business we had never been involved in before-- Samsung phones, MP3 players, digital cameras and all that stuff.

Dobkin: This was with products that were designed as general purpose products. We didn't make customs for that. It turned out that the products that we--

Swanson: We didn't make customs, but we tweaked products. Whether we did or didn't, the really bad thing was all of a sudden, we've got a third of our business that's dependent on many customers who want a significant price break not in a year, every quarter, or they're going to throw us out. And you don't have to be very highly math trained to realize that after a couple years we wouldn't be making any money.

So we made a decision-- they talk about this in this book [*The Company That No One Leaves*], and analysts now have figured out that look, this is the wrong market for us. They won't pay for these non-priced things like quality, delivery, support. They get all the support they need from everybody. They don't care about our better features. They would much rather buy a first generation product at half the price than a next generation product at 50% more, even. And this was not a good fit for our strategy. So in 2005, we told people inside the company and Wall Street what we were doing, and of course, everybody on Wall Street thought we'd lost our minds. I mean how can you grow if you don't do consumer products? They all now understand how dumb that was.

Even some people in the company thought this is crazy. So we redirected the sales force to take no more business from these companies, don't spend your time designing anything in for them. We told the design team to refocus their efforts on more complicated chips for markets like the industrial and automotive market that need more complex solutions and will pay us for those non-price things like quality, delivery, and technical support. For four or five years it was like is this thing working? And now, I think we're considered one of the best positioned companies by the Wall Street folks because we did this. But for three or four years, it was just, was this a dumb idea or a good idea?

Dobkin: One of the problems with the consumer products is every year the consumer end product changes, so if you're really heavily involved there, you have to redesign your product for them. So you don't have any longevity and you've got engineers that are being refocused on redoing what they did last year just to keep the same amount of business. It's not good for growth, unless you have an infinite amount of engineers making up a large number of products because they have double the products.

Swanson: Well, not only is there little or no margin. The volume's so high everybody gets seduced into make it up in volume. But some of these end markets, they have design cycles like every quarter. We're working on projects now that a quick project is three years, a more typical one is four to five years. Then we're in markets like automotive, where it takes another two years to get it designed in. We're making five and seven year bets now, but I think we're well-positioned. Now it's even more critical that we pick the right products, engage with the right customers.

Dobkin: Back when we started, we actually avoided some of those markets. We avoided going into disk drives, we avoided going into areas where one large customer could consume the whole company.

Swanson: Yeah, I mean we started this company to be free to do it our way, to try the ideas we had. And when you get three customers who control 3/4 of your business, you're not free anymore, you do what they tell you.

Laws: [You're a] subcontractor--

Swanson: Yeah, and you eventually go out of business.

Laws: How is the market divided today? What percentage is U.S., international?

Swanson: Well, the way we look at our business, we look at it two ways. We look at where did we create the design? That's another thing that we recognized early on. There's going to be a lot of business created in this geography that's going to wind up being shipped to that geography, and we needed to figure out a way to keep our guys incentivized. We're a paid on performance; we have a field team that can't worry about whether it was designed in Santa Clara and it winds up being purchased in Shanghai, because it takes a long time to design in, so we had to come up with pay plans that worked, and we did.

So anyway, we look at where business is created and where it's delivered. So 44% of our business today is created in North America, the next biggest is 24% is created in Europe, the next biggest is 16% to 17% percent is created in Japan. I always thought if we could do 15% percent in Japan, that we'd be-- that's the goal. Now we're doing 16% and 17%, so we're overachieving my goal. And then the balance, I think 14% if you add them up is in the rest of Asia Pacific, with China, of course, being a big piece of that. Now, if you look at where stuff is shipped, only about 29% or 30% is shipped in North America.

Laws: Of the 44% that's created here?

Swanson: Yeah, and over 40% gets shipped to Asia Pacific. I think Europe there's 25% created and about 13% gets shipped there, and in Japan it's like 17% and 13% gets shipped there. See everybody is outsourcing, but nothing like what North American companies are doing.

Laws: Is that changing at all?

Swanson: I think it's about to change. I hear rumors and I hear anecdotal stories about companies who are disappointed, especially those companies that outsource their design, which always seemed weird to me. I hear stories about designers who have designed a product and never saw a factory, and vice versa. So I do hear all of those anecdotal stories. I think maybe it is coming back, but slowly, yeah.

Dobkin: Back when we started, there were very few really big contract manufacturers. If we sold a product to Hewlett Packard, it was manufactured by Hewlett Packard on their production line. Now there's the big assembly house contract manufacturers. I've seen products that we've designed our part in, they end up at a contract manufacturer, get redesigned by someone there, and our part may get designed out.

Swanson: Well, that's why we track the business the way I explained to you. So we have to have people in Taiwan that when a design comes over from Santa Clara or Boston, it used to land over there and then where did it go? Now we have someone at the other end catching that design and making sure if it makes sense that our ICs stay in it, not because somebody likes one of our competitors better, even though the circuit doesn't work the same.

Laws: Sure.

Swanson: Yeah.

Laws: You have an interesting stack of books there. There must be a story behind those, Dobby.

Dobkin: Well, all through the years we wrote application notes. We wrote design notes, too, but application notes on our products. We've collected those application notes. I didn't write them, I'm the editor of the book. Most it was written by Jim Williams, and they're a combination of applications that we've done over the years put into a book form. There's two volumes, and half of the first volume is right now in Japanese, going toward getting the second half done in Japanese.

Swanson: So this is a good story for a guy like me to understand. Jim designed-in all our ICs. Jim wrote all these design notes and app notes, and people in the field, customers in the field appreciate what he did in written form every bit as much as the ICs that are a critical part of their equipment.

Dobkin: When it comes time to design a circuit, you learn the basics of school. You don't learn the details of how to put it together and how to make sure it works and how to test it in school. You learn that on the job from people more experienced. What we did here [show in this book] is we had circuits that were finished, tested, we gave the circuit, we gave the test procedures, we showed how to debug it when it's not working, so when people start working with circuits, they've got a leg up by looking at these application notes. They're not just sales pieces for our products. They really teach people how to do circuit design, and it's really hard to get that now, because things are made out of ICs. You can't see what's inside the IC. You can get the specs, but knowing how to apply it, that takes some experience, and we're giving away that experience here.

Laws: So these generate design wins for the company.

Dobkin: They generate design wins, they help the engineer. If we don't get every design win, that's fine, but we want to be the guy that the engineer looks to first for a solution.

Swanson: We knew, even when we started the company, that because of the digital craze and so forth and so on, that more and more customers would be analog challenged.

Swanson: So we knew from the beginning this would be good angle for us to exploit, and of course, it's gotten amplified since then. So not only do these help the customer's designer understand what it is he wants to do, but it gives us great recognition as the teacher, as the company that makes it easier for you to use our ICs.

Dobkin: We're very conscious of our customers. We want to make sure that things work right for the customer, because if you get a customer upset or it doesn't work for him and he gets in trouble, you'll never see him again. So that's why we take a lot of care with putting the ICs together, supporting the customer, and getting his design to work right.

Laws: Do you provide complete PC board [reference] designs for them?

Dobkin: Yeah, we do PC boards. Our field applications engineers will do PC boards, we give out PC boards, we give out those designs. We'll fly somebody to the customer to help debug it if we have to.

Swanson: Some of these a demonstration boards, I've seen some as big as half this table, and some have to be worked on for several months. No guarantee we're going to win a design. We have designed many analog sections of our customers' end product-- thousands.

Laws: That's an important part of--

Swanson: Very important process, yeah.

Dobkin: I hear customers tell me all the time I use your part because I know it's going to work when I put it in.

Swanson: Yeah, so the other thing about this that I think you need to understand to fully appreciate the value of this is our direction as a company, our strategy, was to service the mid to small companies. The big companies, yeah, we serve them, too, but everybody serves them. We thought we could develop some real loyalty and some real defensible business if we focused on the small and medium sized customers in good times and bad times. And so, again, I think at that level, this is very much appreciated.

Laws: Sure.

Dobkin: And sometimes those engineers end up with big companies.

Swanson: Yeah, and with big companies, you need a fan.

Laws: What are the biggest changes, Bob, that you have seen in the analog business since you founded Linear, and how have you managed to ride those curves?

Swanson: Yeah, well, fortunately I've been asked that question before. We just celebrated our 30th anniversary a couple of years ago. There are several things, but maybe the biggest thing is how much appreciated analog is today versus what it was even leading up to the dot com bubble, which was more about analog than digital. I heard Gordon Moore say that. But up until the dot com bubble burst, analog was something that yeah, I know, most equipment needs it and so forth, but it's still kind of like last year's technology.

And I think now what more and more people appreciate since the dot com explosion is that not only is analog here to stay, it may not be the majority of the IC business-- in fact, it's a quarter of it or a fifth of it, and so forth, but it's an important piece. And now Wall Street understands and all customers understand that analog has gone from something that they thought was going to be obsolete to something that is forever, and it's a critical part of moving forward with all kinds of applications that were made possible by digital technology, but you couldn't get the products. All these products require analog to finish the job. I think maybe that's where-- I used to spend-- in the early days, for the first, maybe, 10 years, I'd get a 20-minute spot at all these conferences. The first 10 minutes I would pitch analog as a market, and then the last 10 minutes, our name is Linear Technology, this is what we do.

Laws: That's not necessary anymore.

Swanson: Not necessary anymore.

Dobkin: I think over time, the analog designer has become the specialist in analog. When you think, if you go back 30 years, analog ICs were just starting. Let's go back a little bit before that. There was no digital, there was very little. Almost everything was done analog, and those engineers have had to move to digital or they retired. Now the analog comes from the analog IC companies.

Swanson: There's lots of things that I couldn't have foreseen-- applications that weren't in my vocabulary, weren't in his vocabulary either-- PoE [Power-over-Ethernet] and what we call power system management, which people called digital power, and all kinds of micromodules (µModules) and all this telecommunication stuff that we do, functions that I didn't know what they meant. Sometimes I still don't know what they mean.

Dobkin: But the analog business has gotten immensely more complicated.

Swanson: Very complicated.

Dobkin: We have products with processors in them, and why is that not digital? Because the analog portion of it so important to make it work, that it's an analog IC, it's not a digital IC. The digital is supporting the analog.

Swanson: For many years, the tagline on our press releases and so forth was exclusively committed to analog. That's not accurate anymore. I'm not sure-- you can correct me, but maybe not a majority, but close to a majority of our ICs now have some digital content, maybe some significant digital content.

Dobkin: I would say about a third of them have some--

Swanson: Third of them?

Dobkin: Yeah, have some digital content, and the analog content is a lot more complicated. Where the early circuits might have 100 transistors, it's not unusual to have a couple of thousand transistors in our circuits now.

Swanson: We now have integrated solutions on a chip. We just don't make amplifiers and voltage regulators anymore. We make things like battery monitoring systems. You look at the block diagram, and it's like, I can't believe we put all that in one chip and make it all work. It's got ADCs

and power and references and memory. It's got places to store faults and so forth and so on. It's a big chip and it's very complicated.

Laws: Does this open up opportunities for some of your competitors to get better at analog because they still have some of these other devices available?

Swanson: Yeah, I think so, and I think in early days, we used argue with Maxim [about] who had the real gurus. I mean there was this kidding about who's got the real gurus? I think our whole approach was sort of focusing on doing the hard stuff-- we invented the term high performance analog. And I think people saw that this as this may not be where all the volume is, but it is where all the margin is; it's where all the longevity is. If you do it right, you could be around for 30 years, 60, maybe more.

Laws: And your competitors are? TI still?

Swanson: Yeah, well, TI certainly.

Laws: Having bought out National.

Swanson: Yeah.

Laws: Who's next?

Swanson: People ask me who our competitors are, you would have say TI. They're so big and they're everywhere. Analog Devices.

Laws: ADI, of course.

Swanson: ADI, of course.

Dobkin: Maxim still is.

Swanson: And Maxim.

Laws: And then Linear would be the next in ranking of revenue?

Swanson: Yeah, so TI would be the biggest, and then the guys that compare us-- ADI is more than two times our sales, and they're 1.3 or 1.4 times our market cap. Today Maxim is two times our sales and they're 0.9 our market cap. So you can see Wall Street has figured there's some difference between us and them.

Laws: Now Maxim grew by acquisition. Did you ever do any acquisitions along the way?

Swanson: We did do a small acquisition just recently, but not for an analog product. Going back to the acquisitions, we looked at companies. The first company we wanted to buy was PMI. We actually wanted to buy PMI. They wanted $60 million in cash, the family did, and we didn't have $60 million in cash, I think we had $40 million or $50 million. But we wanted them because that's where George [Erdi] came from, part of our early success was in pursuing amplifiers, we'd already developed a reputation, that was just

going to add to it. And so we made the Bournes family a stock and cash deal that instead of being $60 million was $90 million, and had they done it, the $90 million would have become $300 or $400 million. But they needed $60 million in cash, and I didn't have it, so ADI bought them.

Laws: OK.

Swanson: And then we looked at other companies along the way, and came to the conclusion that they were all overpriced if they were good, and if they were good, why don't we just hire half a dozen of their good people, which we did. And a lot of them were for sale for a reason, they weren't worth buying. And we said to ourselves, we're an analog company, we're specialists. If this is really analog, why don't we just do it? We almost bought, or came close to buying, a DSP company. This was an era maybe 15 years ago when the people that had DSP, again, tried to convince Wall Street that you can't survive as an analog company if you don't have DSP, because they go together. And we didn't necessarily buy that, and still don't buy it, but maybe there's some synergy.

So there was a company that we came close to buying, and they were a startup for sale. We had the final meeting to decide whether we were going to buy them or not, and I went to ask the question OK, now tell me again their product's better than Motorola's -- because we've got to be better. Better than AT&T and so forth and so on. The guy in the back room said no, their product's not as good as any of those. And I went what? And everybody said oh yeah, that's right, their product's not there. Well, what the heck are we talking about buying them for? And we didn't.

And so we recently acquired a company called Dust Networks, you probably know them; they're a remote sensor network company. When we first looked at it, we were like wait a minute, it's this huge digital chip and software, what's it got to do with us? Well, what it has do with us is that it's an industrial application play, a lot of our stuff could be around it, and so forth. But it was a small acquisition. We actually took a close look at buying Dallas Semiconductor, and we all flew down there and we talked to all of their managers. And every manager I was asking OK, what are you doing to stay in the game? How are you making the product better? And every one of them had a cost reduction program, which is a big turn-off for me, and so we got on the plane and flew home and said we're not buying that company. Fortunately Maxim did.

Laws: Maxim did.

Swanson: Yeah.

Laws: Have you got some other goodies [materials] there that you think will help us understand the company better?

Swanson: You heard about *The Company That No One Leaves.*

Laws: Why don't you describe it.

Swanson: OK, so there is a book which is a recent book. A lot of books have been written about Linear's success and so forth. What's unique about this is *The Company That No One Leaves*-- this is an English translation that we did for internal consumption-- and it was done by Nikkei, OK, who is like the *Wall Street Journal.*

Laws: Japanese newspaper. Yeah, they're very well known.

Dobkin: Done in Japan.

Swanson: And so they wanted to write a book on Linear, and we gave them a lot of interviews, and they found it surprising that there was a company, an incredible company, like Linear, that's their words, that has this unique engineering culture, a company that has hired really good people that never leave. It was done in Japanese, and we saw the Japanese version of it and had talked about our transition out of consumer and they thought how courageous that was, and Japanese companies should do that, and Panasonic and Sony ought to take a lesson, which is kind of fiction, but that's what the book says. But we liked it enough that we've translated it into English, for internal consumption.

This is the book that also came out, which I like even more.

Laws: And the title is *The Three Rules*--

Swanson: *The Three Rules: How Exceptional Companies Think.* What I like about this book is that they didn't interview a single person from Linear. With a group of analysts from Deloitte, they analyzed several thousand companies in nine different industries, and they picked a company based on a lot of sophisticated statistical analysis and return on asset financial stuff. They picked companies and they named a miracle worker, a long runner, and an average Joe.

In the semiconductor field-- they had medical field, semiconductor field-- in the semiconductor field, they analyzed data from 203 companies. I didn't know there were that many in semiconductors, but there's some categorization that says there are, and we were the only miracle worker. There was a company in Southern California that was a $100 million company, it had been around for 40 years selling to the military, they were the long runner. They compared us specifically to International Rectifier, but they said

there were 23 average Joes, one miracle worker, but here's the three rules, this is what I really like about the book.

They talk about the three rules as kind of glib stuff like the three rules are better before cheaper. Now people have heard me say at Linear that our strategy was to be better before bigger, and the other rule was revenue before cost. They drive profits through price and volume, not thrift. So the way I like to translate this, here's what I think it means for Linear. They say there are basically two fundamental ways companies can choose to stay in the game. One, they can whittle away at cost, so they can be either cheap, the cheap price guy and win on price, or you can innovate. And more winners, more miracle workers chose innovation.

I mean Federal Express, they claim they're an innovator in their business, and Merck, and so forth. So you don't just have to be a technology company, per se, to use innovation to find your niche, that's rule number one. Rule number two I think is an more even more important rule, because many companies can innovate, but the most important rule if you're going to innovate, you need to position your company in markets with customers who will not only appreciate your innovative product, but they will pay you extra for those non-price things-- delivery, quality, reliability, and support. And again, that's what I think we did dramatically different about six years ago.

Laws: Which is the time you switched out of consumer--

Swanson: Switched out of consumer. Now they give us credit for becoming a miracle worker 10 years before that, when our margins were going crazy and our sales were going crazy during the dot com bubble. The third rule is there are no other rules, so I particularly like this book because I think-- and by the way, the other thing I liked about this book is that our strategy of not wanting to be the biggest, wanting to be the best, and wanting to be healthy enough to be around 20 or 30 years later, that's been called a maverick strategy by people on Wall Street. But this book shows us that in eight other industries, miracle workers had the same strategy. So I think it's a great book.

Dobkin: I look at Bob as the president of the company, and I look at him setting the business strategy. I look at other companies and I see the presidents who get their jollies by having the biggest company, and they just keep reducing prices to the point where they're losing money, but they're getting the orders. It just doesn't make any sense now. I've been so long in Bob's company that I can't see any other way of doing business.

Swanson: At 42, my frustration level was at a peak. I used to go to National, want to get up and want to go to work there. I'd say at least 12 and a half of the 14 years, I loved working with the company. It wasn't always easy, but I loved the spirit. And so at 42, quitting a vice president job with decent money and jumping off a bridge, I said, I need to start a company that's going to last for the next 20 years. I need to

have a place of employment for the next 20 years. So the strategy is not to go to the moon and then crash, it's to build it nice and steady, and 20 years from now, I figured I had two more decades to work, it's been three, that the company will still be there. So it was that kind of strategy-- being bigger wasn't what I was trying to do.

Dobkin: If we had gotten paid really well and it had been fun to work there, we wouldn't have gotten frustrated at National.

Swanson: Yeah, I often joke that I-- you know, Charlie Sporck wrote a book on Silicon Valley. Maybe it was more about Fairchild, [he titled] it *Spin-Off*.

Laws: Yes.

Swanson: I can remember, and he came to interview me, and of course, to remind you, they sued us for the first seven years of our existence. They accused me of stealing everything including the doorknobs, which was a joke because there were no doors, but it was pretty brutal. Anyway, we buried the hatchet, the lawsuits were over, and he interviewed me for his book, and he wanted to ask me about why I left. I mean that was going to be a touchy thing, why I left, and of course I color coded it. But he wrote in this book about Linear, and he wrote that he was wrong, that National went full circle and came back to be only an analog company 20 years later. And even before he knew that, he said, hey, the analog business had more legs and more future than I realized, and he gave Linear credit for being one of the best start ups of the '80s. So he's probably still watching how we're doing.

Laws: And after 30 or so years, you have to be handing off the reins gradually to chief operating officers and CEOs. How are you going about that process?

Swanson: Yeah, I handed it off. When I turned 65, I decided after 23 years, the team needed a rest from me, among other things. I looked at a calendar and I said, I don't have the same energy. A lot of people said, Bob, you've still got the same energy, but intellectually, I thought it was time for me to step aside. There were some times I wish I hadn't, but I did. I stepped aside, but I wanted to stay on, and the board wanted me stay on as the executive chairman. I don't think any of us thought it would last this long, I'd stay on for a couple years and so forth.

But one of the first things that happened after I turned the company over was that I realized how deeply involved we were getting into consumer business and how one of the senior managers at the company whose title was president then, not the CEO, had set the strategy to drive us more and more into it. He wanted us to, basically-- if we only had three customers and they were Samsung and Apple and Nokia, he'd be happy. And it was like this is not what we started the company to do. I'd already given up the job as CEO, so now I was in a position where I didn't have as much clout.

I didn't want to be the CEO again, so basically I had to convince the board that I had this idea that I think we're doing this wrong, and they supported me. So then I went to the team and tried to convince them that what we're doing is wrong, the argument the world is changing, what worked before is not going to work now. I said that was all BS, the world is always changing, but some things are constant, we've got to find customers who will pay us for what we do special. The majority of the team agreed with me, and so I realized hey, maybe I need to stick around longer than I first thought. After 25 years, I don't want somebody taking this company and trashing it because of a dumb idea, something they want to put their fingerprints on that's their thing.

So I've stuck around longer, but I am not the CEO. I haven't been the CEO for six, seven years now. I involve myself in strategies. I only pick fights in things that I think are really important. I bite my tongue a lot, I bite my lip a lot, but the company's still doing well.

Dobkin: One of the things that I really liked about working for Bob is he did business by good business practices, not by ego. I've seen too many people come into positions and they just want to feed their ego. We had marketing guys want to change our advertising structure, even though our ads are well recognized and read by customers, they want to make a whole new ad setup because it feeds their ego.

Swanson: Don't let them do it.

Dobkin: Don't let them-- they tried it once and we made them change it back, and we don't let them do it now.

Swanson: We all know Regis McKenna.

Laws: Sure.

Swanson: So Regis had been on our board for while. He's the one that actually helped us with the name Linear Technology. The company's first name was Thobs, which was stands for The House of Bob Swanson. I actually kind of liked that name, but nobody else did. We were looking for a name and Regis said, well, you guys are going to be in the linear business, you're going to be a technology leader-- why not Linear Technology? That would be great, but that name must be taken. But it turns out, it wasn't taken in the U.S., so we took that name. But I remember Regis telling us how much money Apple spent educating people that Apple was a computing company and a personal computer company, to boot. And how long it took even National to have their ads and app notes recognized when people were flipping through books, magazines.

I think the dumbest thing we could do now is to modernize it, but if you change it so when you open a book, all of a sudden our ads look totally different, we'd have blown 30 years.

Laws: Yeah, big investment in brand recognition.

Swanson: Right.

Laws: Well, you've been doing this as long as Mr. Swanson, Dobby. Are you still there every day?

Dobkin: I'm still there every day. See, I don't have a lot of people working for me anymore. At one time, I had the whole engineering team, and instead of doing technical stuff, half the week was hiring, the other half was solving personnel problems, which I don't have now.

Swanson: Bob is one of these dozen people that fly back to the design centers. They'll take off on a Sunday afternoon, go to Boston, go to Vermont, go to New Hampshire, go to North Carolina, go to Colorado Springs, and then go home on Friday night. And then another week they'll do the other design centers. I've seen him go to these design centers where a guy has been struggling with a problem for two and a half months, kind of like ego, doesn't want to ask for help, or thinks it's a shame to ask for help. And Bob will say let me see what you're working on, and solve his problem in 10 minutes. He does that all day long. I think the wonderful thing is that young designers and senior designers feel comfortable going to him with a problem. I think some of them are still surprised at how often you solve their problem.

Dobkin: It was really important when I set up the engineering group that the person who works with a product gets the credit for it. We don't have a manager taking credit for the product that one of his employees worked on. So everybody gets to be associated with what they're working on, no matter who helped them, or what other sources came in to make the product. And engineers, they have egos, too. They're proud of what they're doing. You work on an IC for three or four years, you've got to put a lot of love into it. You don't want anybody to take it away from you.

Laws: Is there a particular product you're most proud of?

Dobkin: Yeah, the one that took me 30 years to make.

Laws: And that was?

Dobkin: It's called the LT3080. I came up with, essentially, the idea for that product when I first started at National, but the technology wasn't there to make it.

Laws: And what does the product do?

Dobkin: It's a three-terminal adjustable regulator that adjusts down to zero. It uses a whole bunch of new things, you can parallel them, you can adjust it to zero. You can use it as a low dropout. It's getting to be very popular now.

Swanson: As a current reference.

Dobkin: Has current reference--

Swanson: What was the technology that you needed to do this?

Dobkin: What I really needed back then was a good resistor.

Swanson: Oh.

Dobkin: And we have it now, but the idea I had 30 years ago, or actually 40 years ago--

Swanson: But think about this, this is uniquely analog. 30 years later, he does a brand-new function that happens to be a three terminal. Is it a three-terminal?

Dobkin: Three-terminal.

Swanson: Three-terminal linear voltage regulator, and it's uniquely different than everything else.

Laws: And the fascinating thing is that you had the idea 30 years ago and it's still relevant.

Swanson: Right, yeah, linear regulators are very relevant still.

Dobkin: They're very relevant.

Swanson: But how do you make a linear regulator that's worth over $1 when people are selling them for $0.15? It's got to have something unique about it.

Dobkin: I think that maybe I'm proud of that because it took so long to get there.

Laws: Are there any penetrating questions I should have asked you think that are appropriate at this point?

Dobkin: I think one of the things that we had was no infighting. I didn't want Bob's job, Bob didn't want my job. I didn't want Brian's job when we started. We all knew what our jobs were, and we went off and we did those. I hear of infighting in other start-ups, philosophy differences.

Swanson: Yeah, so to revisit something that I kind of blew over, why I left National. National got to the point where it was so bureaucratic and so political that we were becoming inefficient. I gave you some examples. I thought my boss should have stamped some of this out instantly, before it festered into-- and he didn't do it. So when I came to Linear, I had all these things that I didn't want to happen-- no matrix management, shut down politics, if I see two guys fighting-- some people think that these two guys are smart, let them fight it out.

My attitude is that's ridiculous, you're wasting time. So I would listen and I'd tell one of them to shut up and we're going to do it this way. I wish my boss did that at National, even if he told me to shut up, at least we would have made some progress. So I think the culture that we've created-- I'd like to think that I didn't design any circuits, I didn't make any wafers, but I've created a culture that is non-political, non-bureaucratic. It's a healthy environment where innovation is possible and innovators want to stay. If there's one thing I can take credit for, I think it is that kind of culture.

Dobkin: I agree.

Swanson: I didn't do it by myself, but again, I've been a good student of what happened at National. I had that Eureka moment when innovation is better than whittling away at cost, and I also saw the things that went wrong. I worked for Transitron at their zenith of success, I worked for Fairchild in its glory days, I worked at National in its glory days, and I saw what they did that caused them to fail. And I said if I can remember not to do those things, maybe we'll last longer than 10 years, and we have.

Dobkin: We're at 30 years and we're still very vigorous as a company. Everybody's still marching in the same direction, trying to get products out, trying to help the customers.

Laws: Do you see any threats on the horizon?

Swanson: Not to sound arrogant, but it's either arrogance or ignorance-- no, I don't see any threats if we stay the course and do what we continue to do better. The threat would be that we did something dumb and lost some of our key people. What would be dumb is to get too involved with a couple of big customers that wound up directing our activity, rather than us directing it. I think it would be our game to lose. Right now, we're winning. I think we'd have to do something dumb to lose. I don't see any technology that can obsolete what we do.

Dobkin: Our product base is diverse. We make products that are very diverse. We don't have 50 engineers working on one product. We have one, two, three, four people working on it. And if that product doesn't sell well, we still have a lot of other products that will.

Laws: Is there an average number of millions of dollars of sales per year per product?

Swanson: It's got a long tail.

Dobkin: We like products-- we won't think of making a product unless we can see it making $1 million a year in a couple of years.

Swanson: Yeah, and so we have many, many $1 million products, many $10 million products, some $50 million, $50 million dollar products. Those are the scary ones, because those are going to become the--

Laws: The targets for others--

Swanson: --the target for others. So on this subject, generally, I used to try to explain to Wall Street folks why we were diversified. How can you be diversified, you're an analog company, you're talking about skimming the cream. I'd say there's still a way for us to have diversity. We have diversity of products, we make a lot of different products. We're purposely involved in a lot of different markets, and we're purposely involved in a lot of different geographies. So if Asia's down, US is up, so forth and so on. They said, OK, fine, I get that. But we actually-- it sounds like blasphemy-- we actually make sure we don't get too big in any one market area.

Now right now, 60% of our sales, I think, something like that, is in automotive and industrial. And that's OK, because industrial in itself is A to Z. Automotive is a big area that needs technology and quality. As long as we can deliver innovation and quality, we can defend our position there.

Laws: And the total analog market, including consumer, these days is what?

Swanson: I think it's somewhere between $42 billion and $44 billion. It was supposed to be $50 billion three or four years ago, but you'd be surprised at how little consumer is.

Laws: Yeah. And the market you participate in, that is how big?

Swanson: OK, here's the good news. Industrial and automotive make up 41% or 42% of the total market. Communications makes up about another 25%. Consumer, per se, only represents 7% or 8%. Now in communications are handsets, they're consumer. Computer is about 20%. I don't know what that adds up to be. So we are heavily involved in automotive and industrial, and here's what's good about that. In the last 10 years, the analog market went from $20 billion to $40-something billion. The automotive and industrial piece has doubled in size. So they went from 20% of that $20 billion to 40% percent of the $40 billion. And we're also involved in communications. We're very heavily involved in the networking part, the base station part, but we're not involved anymore in handsets, which is the lion's share of that communication number. We're involved in military, too.

Laws: Linear Technology is a company in the community. Do you have any foundations or any involvement with the community outside of the corporation?

Swanson: Well, we're kind of a stealth company, but for years we've been a contributor to women's health issues like the National Breast Cancer Coalition, a Washington-based group. We're very much involved in the American Heart Association, the Second Harvest Food Bank, things like that. But we're kind of stealth, we don't stand up and do a lot of bragging about it. We used to be a good contributor to the San Jose Ballet, before it got taken over by new management. So we're involved in a lot of those things, yeah.

Dobkin: We give money to colleges, too.

Swanson: Oh, and colleges-- education is a big deal. That's the single biggest deal we do.

Dobkin: And we get a lot of engineers back, too. It's very interesting. We get engineers that come on a rotation as part of their training--

Laws: As interns?

Dobkin: Yeah, and then most of them come back and they work for Linear. They go back to school with great stories, and then we get a line at our booth for interviewing.

Laws: Are you still involved in recruiting?

Dobkin: Not so much now. The general managers are..

Swanson: But are you asked to interview any of the design engineers?

Dobkin: Occasionally when they come out. If there are engineers being hired now, I'll be asked.

Swanson: Yeah, if they come into Milpitas, they ask you to interview them. You still interview FAEs, I think.

Dobkin: Yeah, I do.

Laws: Anything else you'd like to say before we sign off here?

Swanson: It was fun and it was actually more comfortable that I thought.

Laws: Good, well, it's a great story, and I thank you very much for participating. Two hundred years from now, someone's going to pull out this tape. I don't know what format it's going to be or what media it's going to be on, but it'll give people some insight into one of the most formidable companies that grew in Silicon Valley. We really appreciate you participating.

Swanson: Thank you.

Laws: Thank you, gentlemen.

END OF INTERVIEW