Oral History of Ray Stata

Interviewed by:
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Gardner Hendrie: Well, I'm happy to welcome Ray Stata here with us today who's graciously agreed to do an oral history for the Computer History Museum. Thank you very much, Ray.

Ray Stata: My pleasure.

Hendrie: I think I'd like to get started with your background. If you could maybe give us some sense of where you grew up, what your parents did, you know, sort of the background or the milieu that you grew up in as a little kid.

Stata: I grew up in Oxford, Pennsylvania, in farm country. I had a chance with my grandparents to spend a lot of time doing farm work. But also, my father was an independent electrical contractor. So I had a chance to work with him around town, wiring houses, things like that.

Hendrie: Okay. Where is Oxford?

Stata: It's southwest of Philadelphia.

Hendrie: Okay. Is it near West Chester or that area?

Stata: Well, it is. It's probably 40 miles from West Chester. It's about 60 miles from Philadelphia.

Hendrie: Okay.

Stata: Kennett Square's best known as the Mushroom Capital of the World at one time. So it's just maybe 10 miles south of that on Route 1. Today it's horse country. They train horses there, race horses, and so forth.

Hendrie: Yeah, it's beautiful country. Do you have any brothers or sisters?

Stata: I have one sister who's deceased now who was a nurse.

Hendrie: Did your mother work at all? Or was she basically a homemaker?

Stata: She was more of a factory worker. She worked in the Oxford Kitchen Cabinet Company, for many years making cabinets.

Hendrie: Wow. That's very interesting. <laughs>

Stata: During the war years, she and my father both went to Middle River, to the Martin Company, where they built airplanes during the war. And I actually spent some years there in school, during those war years.

Hendrie: Where is that? Is that in Maryland, outside Baltimore?

Stata: It's near Baltimore.

Hendrie: Yes. Because I know Martin sort of started in Baltimore.

Stata: Yeah. They built the amphibious planes there, amongst other things,.

Hendrie: All right, that's very interesting. So you did some schooling in the local schools? Was that your first schooling?

Stata: Well, you mean in terms of the K-12 years? Yeah. My schooling was quite unusual. The first school I went to was a one-room schoolhouse that had eight grades in one room. I went there for one year, and then that's when my parents moved to the Martin Company down near Baltimore. And I went through grades two, three, and in the case of three, twice, and fourth grade. Then I came back to Pennsylvania and went to another school in the fifth grade. And then I went to another school in the sixth grade. And then I went to another school in the seventh and eighth grades.

Hendrie: Oh, my goodness. Is this because you moved or it was a different school--

Stata: Yeah. I was moving around and also spending time with my grandparents at different times. And then I went to Oxford High School for four years. So that was the first time I had any continuity in those years. Interestingly, in the war years, the schools were so overcrowded that the teachers didn't even know I was there when I went through the third grade, so they failed me. I had to repeat that year, because they just didn't know I was there. And I didn't pay much attention either.

<laughter>

Hendrie: And you weren't very interested either, in what was going on.

Stata: Yeah.

Hendrie: All right. That's fascinating. What is your earliest memory of thinking about what you wanted to do or be when you grew up?

Stata: Well, as I got into really the high school years, I found some books in the library about science, engineering, technology, and started reading and became, you know, avidly interested in that. So I knew in terms of continued study I would like to learn more about that. But as I mentioned, my dad was an independent electrical contractor. You know, farmers are essentially entrepreneurs who are very independent. So the environment in which I lived and was brought up was very entrepreneurial really, in a small way. And on top of that, I had a serious aversion to authority. So <laughs> one of the things that very early in my high school years, I had kind of decided was that, whatever I did, I wanted to be my own boss. So that implied starting a company, doing something where I wouldn't have to take orders from anybody.

Hendrie: Were there any particular stories you remember in the high school years that sort of demonstrated <laughs> that you didn't like to be told what to do?

Stata: I think it was pretty generic across the board. It was just my independent nature.

Hendrie: Okay.

Stata: And I wouldn't say I was rebellious necessarily, but I like to chart my own way and be in control of my own destiny. And I could see that in terms of careers. I knew about people who work for people and somehow or the other, that didn't appeal to me. So that whole notion of autonomy and being in control of my destiny, you know, working for myself. You know, one of the early possibilities, my dad had an electrical contracting business. Maybe I could build that into something more significant or whatever. So it was not grandiose in terms of any thoughts about what it might be or become. It was just to have independence.

Hendrie: Okay. It's hard to imagine grandiose schemes when you're in Oxford.

<laughter>

Stata: Yeah.

Hendrie: Good. So you figured that out about yourself at a relatively early age.

Stata: Right. Right.

Hendrie: What were the subjects that you enjoyed the most in high school?

Stata: Well, I like to learn in general, so I enjoyed them all. But math and science were of particular interest. Now, we didn't have, you know, the greatest teachers in our little high school. So frankly, I learned probably as much out of the classroom as I did in the classroom. Probably the librarian was the person I got to know the most in my high school. And she was very helpful in pointing me, you know. "These are the books to read," and so in terms of literature, history. And that's where I bumped into the material on the history of science. And found that just so, so fascinating that I wanted to learn more and more about that.

Hendrie: All right. Were there any subjects that you disliked? Languages or anything like that?

Stata: No, huh-uh. Actually, across the board I took Latin. <laughs> Enjoyed Latin. French.

Hendrie: Okay.

Stata: Now, there was not any particular dislike or any unusually strong affinities, as I had in the case of, you know, math, which was a more challenging area to learn and to know more about. And certainly the whole thing, science, you know. The whole history of science and the things you learn in science and chemistry in high school, those were quite fascinating.

Hendrie: Okay. So talk to me about what you remember about your thoughts when you were getting close to graduating. Was college always, in your family, so that you knew somehow you were going to go to college? What was the family culture there?

Stata: Well, I was the first in my family to ever have gone to college. So there wasn't a lot of encouragement or knowledge about that subject, so I didn't get much, well, encouragement or support from the family in terms of what to do. But in my own mind, I knew that I would want to go on beyond high school and learn more. By that time, engineering and science was my area of interest and a very interesting and fortunate thing happened to me when I was a sophomore. Playing basketball, I jammed my neck against the wall in the gym and ended up in a hospital for about a week. Serious traction is sort of what they had to do. And it turned out in the bed next to me was an elderly gentleman who was or, had been, an engineer. He knew a fair amount about the engineering education in various schools. So we had a wonderful time talking about the subject, which I knew nothing about, as a career, but most importantly in terms of advice about what are the schools I should look at. And he was very, very clear about that. He said, "If you want to study engineering or science, there's only one school that you should think about, that's MIT." I'd never heard of it and didn't know anything about it. And he just said, "Just set your sights on that. If you can get in there, don't worry about anybody or anyplace, else." So I went back after I got out of the hospital and started reading up on MIT and had my heart set on that.

Hendrie: Okay.

Stata: And then, when I became a senior, I took a test in NROTC, and from that won a four-year scholarship. Except MIT did not have NROTC. They had ROTC, but not the Naval version. But Rensselaer Polytechnic Institute had it and as a matter of fact, I did look into Rensselaer as an alternative. And so I had a dilemma, because my family was not able to support me in going to a university, and here was a freebie. So had I not met that gentleman, <laughs> and with those thoughts ringing in my ear, it would've been difficult to turn that down. But fortunately, I had my heart set on it. They have a need-blind policy at MIT, so they say, "Hey, don't worry about the finances. Just get accepted and we'll work it out."

Hendrie: Very good. So the need-blind policy was also very influential in you ending up at MIT. Because Rensselaer's a very good school.

Stata: I just decided. <laughs> And it was just up to them to decide if I was admitted. And yeah that's a policy they continue until this day. And as a matter of fact, of the elite schools, they have more first-time, in the family, to go to college applicants there than any of the others. So engineering is a place where upward mobility is common and it's a place where people from my background often go.

Hendrie: Okay. So you chose MIT. You go to MIT. Do you have any idea what you're going to do when you get there? What's the environment when you arrive at MIT?

Stata: I did make a point to take a train and go up to visit MIT before I started just to see for myself what it was like. First time I had ever been out of the state of Pennsylvania. An interesting trip, and I got a little sense of the campus. They have you go out to lunch with students and various other ways of introducing the school. So I knew a little bit about it, but it was only when I got there and jumped in the water that I came to understand what it was about in terms of the incredible intensity of work and the bright, ambitious classmates that were there. So it became clearer. My preparation was no match for the Bronx High School of science, right? I'd never heard of calculus, never took any.

Hendrie: Yes. Wow.

Stata: And so I was going in behind the wave with respect to many of the students. Not all, but many. So I must say, I had concerns about whether, you know, could I really do this? Could I keep up with the crowd? Could I do the work? So, in the early days, that was my preoccupation. Once I got through the first semester, that first year, then I knew where I stood and what I could do and what I couldn't do and I could handle it. Yeah.

Hendrie: Now, did you have any idea what you wanted to major in when you arrived on the campus? Or did that not develop for a while?

Stata: I think probably 50 percent of the freshmen who enter MIT would've studied physics, because that's what they learned in high school and that's so fascinating and interesting. What is engineering? I mean, you didn't really understand or know what that was. So I intended to study physics even though as a career I understand that probably engineering would be the place I would end up. They have a policy at MIT that you don't decide your major until the end of your sophomore year. So you have two years to ruminate. And during that two years it became clear from really more a career perspective than necessarily an academic interest that engineering was the place to go, so I joined the Department of Electrical Engineering. They didn't have Computer Science in those days, so it was Electrical Engineering.

Hendrie: Okay. Now, MIT's famous for having, you know, all sorts of ancillary activities. They had, in your era, I'm sure, the model railroad club which was a big thing that people who were potentially going to be engineers got involved in. And there were people working on, maybe not when you were there but a little bit later, programming computers to play chess and doing non-scholastic things. Were you ever tempted by any of those pursuits?

Stata: No. I was very interested in sports, and so I joined the soccer team. Well, we have quite a few students that come from South America and Europe. And very soon I found out what a really good soccer player was like. <laughs> And so my career in that area didn't last too long.

Hendrie: <laughs>

Stata: And I've always been interested in music, so in various and sundry ways, you know, I spent a long time learning music and studying about music, more so than as a performer. But beyond that, it turned out I was a pretty busy boy. Part of the need-blind admission policy is you've got to work. And back in those days, they expected a fair amount, because my parents could contribute very little. And as things went along in my college years, my parents became needy of support. So part of what I had to do in the summers and even partly during the time I was at MIT was to make some money. So it turns out that, unfortunately, I missed a lot of those extra things at MIT. I became part of the leadership in Eta Kappa Nu and in Tau Beta Pi. I was the president of Eta Kappa Nu for a few years. So I think I took on those kinds of professional activities, but not very much that was time consuming.

Hendrie: Okay. What did you do initially for the work part of your work study?

Stata: Well, you start at the bottom. You actually make beds and clean rooms. And as you go along, you graduate to the library. And then by your senior year you actually can work in research labs as a lab assistant. But there's a hierarchy. You start down at the bottom. Doing hard work. <laughs>

Hendrie: All right. So when you worked your way up, and got up to the lab assistant level, what lab did you work in?

Stata: It was the Instrumentation Lab. Today it's called the Draper Lab. MIT was famous for the invention of gyroscopes that had sufficient accuracy to guide submarines and so forth. So it was a very famous place in terms of gyroscope technology and guidance systems in general. So I worked there. I had joined, the 6-A program, it's a co-op program. So you alternately go to school and go to work during those years. And then as a graduate student I did my thesis in the Instrumentation Lab.

Hendrie: All right. I was going to ask about your co-op experience. When did that start?

Stata: That was in the junior year.

Hendrie: Okay.

Stata: Yeah. So you would alternate semesters.

Hendrie: Now, did you work in the Instrumentation Lab for your co-op part or did you work outside in some companies?

Stata: The actual co-op experience was at Philco, in Philadelphia, in their semiconductor research lab. And I selected that. Of course, you apply and then everybody wants to go to Bell Labs, right. So not everybody <laughs> gets to go there. But I wanted to be in Philadelphia, close to my parents, because there was, you know, need for various kinds of support. And the interesting thing is that my supervisor in my first assignment at Philco was Robert Noyce. He had just graduated from MIT, taken a job in the research labs there in Philco, and was my supervisor.

Hendrie: Oh, my goodness.

Stata: So I got to know him as a supervisor. Remarkable, remarkable man. And throughout my career, I stayed in touch. I never took advantage of the fact that I knew him, but every once in a while when I had a really tough problem and I was trying to really think about something where I needed wise advice, I'd get a hold of Bob. He would never refuse me, and I always got tremendously wise advice from him. But that was quite fortunate.

Hendrie: Isn't that interesting?

Stata: Yeah.

Hendrie: So you went on, and took the program that led to a master's degree in electrical engineering.— Tell me a little bit about your thesis at the instrumentation lab. What did you work on?

Stata: It had to do with measuring the non-linearities of the sensors in gyroscopes. So it was, to a large extent, an instrumentation exercise. It was fairly sophisticated. We were looking for parts per million kinds of variations and non-linearities. So I got heavily into instrumentation.

Hendrie: So did you have to build an instrument to do the measurements?

Stata: Yeah. We had to put together instruments and set up a system to be able to measure the stuff. And then there was some feedback theory involved with that, so there's some aspects of stabilization, of feedback loops and so forth. It really wasn't a very sophisticated thesis. I learned a lot about instrumentation, but I don't think it moved my academic research career very far.

Hendrie: Okay. Probably not untypical of master's levels thesis.

Stata: But it had an influence as we go forward here. I got acquainted with instrumentation. I got acquainted with HP, and when I graduated I went to work for HP.

Hendrie: Now, how did you become acquainted with HP? Were you using some HP instruments?

Stata: Right, right. And I got to know the salesman for HP. And he just talked so glowingly of that company. And he encouraged me strongly to, "Hey, look. Go take a job for HP. You'll never regret that." So I looked into it. My interest in taking that job was to become a salesman for HP. Because in the back of my mind this thing about starting the company was still buzzing around. And I thought a good way to learn about business would be to get into the sales department and actually work with customers and understand how transactions were done and about competition and all those things. So my few years there with HP were sort of like a mini MBA. You know, I observed very carefully the management of that company and I read a lot about the company and learned a tremendous amount about what business is all about and how to do it if you do it right.

Hendrie: So what was your specific job and where was it at HP?

Stata: Well, the first job was an intern at HP, where I spent maybe 18 months. They really trained you rather thoroughly and I think part of that whole orientation program was to convince you to become a lifelong employee of Hewlett-Packard.

Hendrie: Okay.

Stata: And so I moved around from the engineering labs to manufacturing, to the sales department, to marketing.

Hendrie: Now, this is all out in California?

Stata: Yeah, Northern California. So I had a chance to see all aspects of the business and understand it at least superficially.

Hendrie: I hope they paid you.

Stata: And they paid me. Yeah. And they paid me well. Right.

Hendrie: Good.

Stata: So that was a tremendous experience to observe first-hand the HP way. It turned out to be, very compatible with my own thinking about how you treat people and how you work with people. It was a great learning experience.

Hendrie: So what did you do after the internship?

Stata: Then I came back to New England and actually carried a bag and sold instruments for a few years. Yeah.

Hendrie: Okay. Do you remember how long that period lasted?

Stata: Well, I mean, I was hesitating for a minute to think. How did that work out? I graduated in '58, and started my first company in '62. So there were about four years there. And so maybe a year and half in California. And the rest of it as a salesman.

Hendrie: Okay. Out of New England?

Stata: Out of Boston, right.

Hendrie: Out of Boston. Yeah. You didn't go back to Philadelphia?

Stata: No.

Hendrie: All right. Well, so talk to me about your thoughts or the process that led up to you deciding to start a company.

Stata: When I came back from California, I took an apartment in Harvard Square. And one day I was just sauntering around and bumped into a classmate who had also worked at the Instrumentation Lab. And he was desperate to find a roommate. So I said, "Fine. We'll go together and find a place to rent," which we did. He had an inclination, not I think as strong as mine, but nonetheless, an inclination to want to start a company also. So we spent nights and weekends for a long time talking about, "Why don't we do that? What shall we do? How do we start this? What's the product?" And we could never figure that out in terms of having a business plan with a very clear mission that you go out and raise money on.

Hendrie: Yes.

Stata: So we didn't do it that way. We just quit our jobs and started the company with a very feeble notion of what we might do. And essentially no money. My wife supported me. He was single; and didn't need much money. And the way we paid the bills is while I was at Hewlett-Packard I learned about a company in Boston that bought power supplies in rather large volumes for printing machines that were made for the government. HP was never able to compete in that business because the prices were too cheap. But I knew about that business and I knew about the vendors for that business. So what I did was to go to one of the vendors that was not servicing that company and worked out a deal where we would effectively become their representative. And we would actually help translate the design requirements, for manufacturing these custom design power supplies. So they manufactured and we sold them, and made some money. And this funded the beginning of development of a rate table for testing gyros.

Hendrie: Okay. That's another subject you knew about because of your time at the Instrumentation Lab.

Stata: Right. We did things that we knew about. And we bought the direct drive motors and the tachometers from a company called Kollmorgen. So we developed this table, and during the process of this, we interfaced quite a bit with the technical people at Kollmorgen. And in less than a year they said, "Look, we want to start a controls division to have electronics to go with our motors. Why don't we buy your company and you help us set that up?" So we sold it in less than a year. So it was, I often say, a failure in every respect except for the cash. What we got wasn't a big nest egg but it was a nest egg.

Hendrie: Yeah.

Stata: And so we agreed to work for them for two years and learned a bit more about business by actually doing it. But more than that, we got the idea to start Analog Devices. So that venture, even though it was ill-fated in most respects, gave us a nest egg and gave us the idea to start Analog Devices. And essentially that idea was, if you made an instrument or any sort of analog electronics, in those days, you invariably had to have operational amplifiers. It was a very fundamental building block of any kind of an analog system. So we designed and manufactured our own at Kollmorgen in very small quantities. Everybody did, because there was nothing on the market to buy. So we were there for two years and during that period, some companies started selling operational amplifiers such as Philbrick and Nexus.

Hendrie: Is this when Philbrick got started?

Stata: Yeah, the first to offer modular op-amps. So now we had a choice. Do we make them, or do we buy them? And when you go through the analysis for small volumes, it's pretty obvious what to do. So we then began to buy the operational amplifiers, and as part of that process we visited all the suppliers and we concluded, "Voila, this is it. We can do a better job than they can do." And it was a very nascent industry. It was just getting started. There weren't any big companies. So after our two years was up we quit and started Analog Devices.

Hendrie: So that gave you the opportunity to survey all the competitors while you were buying operational amplifiers for a while. And you saw that you could do better. Very good.

Stata: Yeah.

Hendrie: I'd like to roll back just a second. You mentioned that Maria, your wife, supported you during this phase when you plain quit to start a company. Could you just tell us a little bit about when you met her and how that happened?

Stata: Yeah, she was the assistant to the boss of the rep company. When I first went to work for HP, as a sales guy, it was as part of a rep organization. They didn't have their own sales organization. Now predominantly I focused on HP but, nonetheless, it was part of a rep organization and she was the bosses' assistant that did everything. That's how I met her.

Stata: That's how we met. He had a propensity for hiring beautiful women, and that place was loaded with absolutely gorgeous women. And, my wife was the most beautiful of them all. So we got to know each other. I worked for the summer, in the office in Boston, for the rep organization before I went to California. I got to know her there, and we corresponded vigorously over the next period of time, and then when I got back, we ended up getting married. Now the week we got married, was the week I quit my job, so she didn't know what she was getting into -- well she did.

Hendrie: She was clearly very supportive.

Stata: Very supportive. So, 50 years later, she's still very supportive.

Hendrie: So, you decide to start this new company, Analog Devices. How much money did you have to put into it?

Stata: Well, we each had 50,000 dollars, in stock, from the sale of the first company and that was our little nest egg. It turned out that on top of that we had very good relationships with the company that we had been working for and they wanted us to finish a project we were working on. And not only finish it, but actually make some of the products. So our first customer was the company that we had worked for. And it turned out, that wasn't an operational amplifier, but it was a way of making some money, right? And also, while we were working, we actually hired a consultant, who was an expert in operational amplifier analog electronics, to design our first products. We didn't do it ourselves, because of concern over conflict of interest. But we essentially paid a consultant to design our first product. So when we opened the doors at Analog, we had products designed, we had a contract with our prior employer. And so, in the first year, we were actually able to make a little bit of profit.

Hendrie: Nobody knows how to do that today.

Stata: Yeah right, that was back in the days of sweat capitol. But anyway, we worked out an arrangement with the First National Bank of Boston which was quite unusual. They said "We'll loan you a dollar for every dollar you earn," 1:1 equity ratio, effectively. So we had to, every day, we had to make sure that we were growing, but also making enough money to pay our way. So we financed the company that way, with the nest egg, with my wife's support, with the contract we had and with the First National Bank of Boston. We didn't go public until four years later.

Hendrie: So, after you got started, who was the designer of your products?

Stata: Well we divided the duties up between my partner and I, and he basically was the designer. My interests were more in the business development, figuring out what to design, and how to market it and promote it and sell it, and the administrative aspects of running the business. But we were a true partnership, we stood under the street light and literally flipped a coin, as to who was going to be president. But neither one of us was the other's boss, which is both good and bad. But, in any event, I took care of the sales, marketing, administrative, financial, all those aspects of business. He did the design work, we hired a few people from MIT that we knew, to get started and then one by one we recruited a team of people.

Hendrie: Talk to me just a little bit about the development of the operational amplifier business, the early evolution of it, from a product and technical point of view? I've seen pictures of the original device.

Stata: The way they were designed was with discreet transistors, discreet resistors, and discreet capacitors. In order to get rid of the variances between the transistor characteristics, we would hand match them to make sure that their offsets and so forth were well matched. And then assemble them on little printed circuit boards and then put epoxy around them, with pins out the bottom. So it was a plug-in hockey puck, really. The dimensions were like an inch by an inch, by a half inch, that sort of dimension. We actually stood the resistors up on their end and bent the wire down so that we would not take up too much board space. We got a high packing density in that way. So that put a limit on minimum height of the module. But, looking ahead to what we did in later years, I mean it was quite primitive. We focused on performance, to have the best performing products on the market. We pioneered a modular plug in chopper stabilized operational amplifier and a parametric amplifier for measuring femtoamps. So we had some pretty sophisticated operational amplifiers, because we were serving the instrumentation market. And a lot of variety, because there were so many different applications for op-amps, no one design would meet all the needs. So we had a growing list, hundreds of different modules over time, that people could select depending on their particular need.

Hendrie: So talk to me about the next steps, as your business is growing?

Stata: The next big step is within three years within our little patch of competitors, we emerged with the largest market share. We were growing 80-90 percent a year, we were making good profits. We were beating Philbrick, both on the sales and marketing side of that equation, which is its own story, as well as in terms of performance of the products. So, it is still a relatively small market. I think in the fifth year, we did something like 10 million dollars, that's in 1970, dollars. So it wasn't a huge market. So then, we began to say, "Where do we go from here, what are we going to do next, what's beyond operational amplifiers?" Now we had, by our third year of business, we had tens of thousands of customers. They didn't buy very much, but there were a lot of different types of customers, universities, small companies, research labs, etc., so we had quite a wide range of customers. So we decided to ask those customers the question we had asked ourselves, "Do we make or buy this function?" And the question that we put to our customers was, "If you could buy this function, if it was on the market, which of these products would you purchase?" So we had a list, you know; log amps, multipliers, converter products, and sent out a survey. The response came back overwhelmingly, first we had a very large response and it was quite singular in saying "Converters," because that's when the minicomputers were just showing up in the market, people were doing computerized instrumentation, and they needed to do analog to digital conversion. So we decided "Okay, that's our next product." And to get into that, we initially tried to design our own converters using our op amp engineers. But we soon found that they were good op amp designers, but they didn't know much about converter products. So I looked around, and found a company right here in Boston, Pastoriza Electronics. Jim Pastoriza actually had at one time, an affiliation with George Philbrick, they were close friends. And he was one of the pioneers, in terms of the development precision converter products. So we bought him. And, Jim helped us figure out how to make converter products.

Hendrie: Okay, how did you convince him to be bought?

Stata: Well, it's interesting, because when we bought him, he had 1 million dollars in the bank. His sales were only one or two million dollars, but they were very profitable, he had been at it for a while, there was no earthly reason for him to sell his company. But, I guess I was able to convince him that we could do bigger, better things together than separately, and he agreed, and we did it.

Now there was one other little piece that was happening in the meantime, that helped, and that is when we first started the company in 1965, there were no linear integrated circuits, there were no IC op-amps. The first ones came on the market, in about 1967. They were pretty pedestrian in terms of their performance compared with what we had. So, they weren't a competitive threat for the instrumentation market, but every year that went by, they got a little bit better. So, I concluded that we better figure out how to get into the semiconductor business, or our life would be short lived. So during the time that I was wooing Pastoriza, I was also in the midst of figuring out how we were going to put together a semiconductor company. So, I think that had an appeal too as well, to be able to actually design semiconductor products and not just buy transistors, and put them together on boards.

Hendrie: Okay, so he saw he would like to evolve his business, and recognized that semiconductor technology was important.

Stata: Right, so as I said, the performance of the first IC op-amps was really not anywhere close to what instrument companies would want to buy. But every year they got a little bit better, and to me, the trajectory was clear enough, and of course they cost an order of magnitude less. And there was reason to think that you could figure out how to make precision op amps. So I became convinced that we just had to do it, because if we didn't, maybe it would be five years, maybe it would be 10, but we wouldn't have a business. Now, as I mentioned we were doing quite well, we were growing rapidly, we were making good profits and everybody disagreed with me. I mean, everybody disagreed. The engineers didn't know how to do it and they didn't want to do it. The finance guy says "We don’t have enough money to do this, so we can't afford it. And besides most importantly nobody knows how to design and manufacture ICs."

Hendrie: And the board, presumably, was in the same camp?

Stata: Yeah, we had just gone public, a short time before. Without having gone public, and raised a little money, I mean it would have been impossible. But I had found some engineers from Transitron, who wanted to start a linear IC company. So I tried to convince our board that we should fund them, as a way of entering into the market. But they disagreed, and as a public company, they had the vote. So I decided, with my wife's support, that we would borrow money on our Analog Devices stock that just recently went public, and fund these guys who wanted to start this company Nova Devices. And the conditions would be, because I was still chief executive of the company: " Analog, had the option to not only sell the products designed and manufactured by Nova Devices but also within a window of time, Analog Devices had the option to buy Nova Devices at fixed pre-determined price, with no gains to me. And if it doesn't work, I'll lose my money." So the board had no choice, they had to accept that. And most people thought my wife and I were foolish to do that, and maybe we were. But, I figured I was young enough that if it didn't work we would go to something else. But that if we're going to build this business, we've got to do it with a long-term point-of-view in mind.

Hendrie: What was the name of the company?

Stata: Nova Devices. They had no visibility, because they sold the products through Analog Devices.

Hendrie: So the products were all Analog branded, and they just designed and manufactured them?

Stata: They had their difficulties getting up and started, but they nonetheless got through the hurdles in producing products, selling them through Analog Devices. So Analog took its option, and bought the company.

Hendrie: Now did they build their own fab, to do this?

Stata: Yes. We were up and running in Wilmington, Massachusetts. Of course, this was back in the days of inch and a half diameter wafers, then we got up to two inches and to three inches. Maybe there would be a couple of hundred components on an IC, or fewer. But nonetheless, we had a wafer fab, and a small clean room.

Hendrie: Were there any technical innovations that they had to come up with, to build the linear IC's that were of the quality of the other products you had. You weren't going to try to compete with National Semiconductor, or someone like that, I assume?

Stata: Right, so we had to do something clearly better than the big guys, who were out there selling a lot of op amps. And so, we took an idea that we really got from the manufacture of modular converters where we sandblasted resistors, to adjust the resistance of resistor networks. So we essentially had a trimming operation by sandblaster. So the question was, is there some way we could transfer that technique to an IC? So we came up with the idea of depositing thin film resistors on the surface of a traditional IC, and then laser trimming those resistors, so that we get a great deal more control over the offset and also the temperature drift. We figured out ways of being able to trim out the temperature drift of op amps. So, we started out by trimming. You put the part in the package, and one by one, you trimmed it actively measuring then trimming iteratively. Then we learned to do that on the wafer level. So, we set up a stepping table and the laser would go from resistor to resistor on a die and then to the next die, and go resistor by resistor, and so on. So we got very sophisticated in learning how to do that, so we could produce products with performance that the big guys just couldn't do. We were selling mostly to the instrumentation market that needed that performance. And of course, that capability was fundamental to making converter products. You had to be able to trim resistors to build converters.

Hendrie: Were there any issues in isolation of the various transistors on the substrate that were more difficult in the linear world than in the digital world?

Stata: On the bi-polar technology side of it, we essentially used industry standard techniques. But step-by-step we improved them. It wasn't until much later that we developed techniques of bonded wafer, trench isolation, much more sophisticated ways of doing things.

Hendrie: But you didn't need that?

Stata: We didn't need that in the beginning. So laser trimming resistors at the wafer level was one breakthrough, in terms of innovation that distinguished us from our competitors. The next early important innovation was complimentary bi-polar. We looked at the progression of MOS technology that started out as NMOS and PMOS and then eventually combined those transistor types into CMOS. But the benefits of that complementarity had never been explored in bi-polar circuits.

Hendrie: Right, I had never heard of it.

Stata: One of our innovative engineers got the idea of building that kind of a process. So we were pioneers in the development of this process. The speed and accuracy that we could get from that kind of a complementarity was much better than the competition. And then, over time, beyond that, we did the bonded wafers to get the isolation on the bottom of the pockets and trench isolation on the sides. So we had essentially totally isolated pockets, in which we could build these transistors and that reduced capacitance and coupling. And that was another breakthrough, so we had several breakthroughs in terms of the process technology, but also, on the circuit side, we had some very, very talented engineers that kept coming up with new and better ways of designing circuits.

Hendrie: How did you find or attract the innovative people on the process side or on the circuit side? Did you develop or hire, at some point, a circuit guru or a process guru who was able to identify and hire more people that were like him? What was the magic, or was it just being a good company?

Stata: Well, our business strategy was always "Business success is built on innovation." And if you want to have innovation as your game, then you have to have great innovators, you have to have the best innovators. And out in Silicon Valley, they had Bob Widlar, and a whole list of very innovative op amp designers, as well as other circuit designers. So an important part of our strategy was to somehow build a competence, in circuit design, that was on par with the best. In the case of Barrie Gilbert, he was at Tektronix, and had already developed a reputation as being one of the more innovative designers of circuits for oscilloscopes. Because his mother got ill, he went to England to look after her for a bit. I tracked him down, in a town over in England, and convinced him to join Analog Devices. I told him that we would set up a lab for him, in England, to do the design if he would join our company. So, he was one of our first really stand out, world-class, gurus. Another one was Paul Brokaw, who worked at Arthur D. Little, and who found us. He had been designing using discreet parts and wanted to learn how to design in silicon. So he looked us up and said "I would like to come to work for you, because I want to learn how to design semiconductors." So those were our two initial ones that turned out to be totally world class.

Hendrie: Do you remember what the time frame was when you attracted those two?

Stata: It was 1972, when we hired Barrie Gilbert in England, and it was about the same time, plus or minus a year, when we hired Paul Brokaw. That would have been in I think about '71-'72 when we hired Paul. But then, in the meantime, it turns out we had quite a few MIT guys working on the modules. And we had Jim Pastoriza, who's a world-class engineer, working on the converters. Those guys converted to become semiconductor designers, on their own, and they became quite competent. So a big part of the building of Analog, was building a world-class circuit design, process design competence. So we worked at that, literally.

Hendrie: You've gone through the evolution from the op amps to the converters, where do you go next in building the company?

Stata: Well, we go back to the well, which is our customers, who are all linear analog instrument systems companies, who buy op amps, that's the most ubiquitous component. So we had this universe of customers, who we could keep going back to and say "Oh, what else do you want to buy?" Or sometimes they came to us, and would say "Could you make some of these, or could you make some of those?" So essentially, by focusing on that customer base, is where we derived our ideas for new products.

Now, it turns out that the gurus like Barrie Gilbert, and like Paul Brokaw, came up with their own ideas about what the world needed, without asking anybody. So we had one of the first and most successful temperature sensor semiconductors, you know. And Barrie Gilbert did a lot of work in log amps and multipliers, just because he felt the world would want them, and indeed they did, They did want them, even though they didn’t know they wanted them. So we did some of that, by dreaming up our own and some of it by customers telling us what they wanted. But, we always did focus essentially on instrumentation, in the early days. Later on we, for various reasons, reached out beyond that.

Hendrie: Now, talk to me about what is next in the product space, after the converters?

Stata: Well, there were converters, there were-- as I say, there were temperature sensors, there were multipliers, there were linear isolators. There were a wide range of products that drew upon our knowhow in designing analog circuits. Kind of the next big breakout from that was Digital Signal Processing, DSP’s. And, again, we found in our customer base, they were buying our converters, and converting from analog to digital and from digital to analog, but there was a piece in the middle that was missing, the ability to process signals in the digital domain. So essentially, the idea for that came out of that same customer base. The idea that we needed to get into the DSP business, to offer a more complete signal chain so that customers could decide, if they want to process signals in the analog domain fine, if they wanted to process them in the digital domain, fine. "We'll take the signals in and out of the DSP." And that became quite a point of departure for a company whose name was Analog Devices. Again, that was not a popular decision in the company, most people felt we should stick to our name, since we didn't know that much about the digital world and maybe we should stay away from it. But, we did it anyway.

Hendrie: So tell me a little bit more about the story of how you got it started, you know, the idea came from the customers, it sounds like you were a significant factor in proposing it be done.

Stata: My role in the company was pretty much figuring out, "Where do we go next, what is the strategy of the company, what's the basis of competition," and so forth? So I was one of the chief strategists, you might say, of the company. So yeah, I was the one who identified and sold the opportunity for analog to participate in that world. So we just did it.

Hendrie: There were big elephants, such as TI, in this space already weren't there?

Stata: Texas Instruments and what was it, AMD was in that space. There were definitively other companies providing DSP. So, from that point-of-view we were a late comer. But I just saw it as a part of a package. We needed to be able to deliver the complete signal chain to the customers, and become more conversant with digital technology. So, I think most people would say "Too late, too little, shouldn't do it." But we did, and step-by-step found ways of doing things better than other companies in that domain, and having leadership products. And it ultimately came to fruition, much later in the story as we began to move toward system solutions, that having the ability of programmable devices and DSP processing would be indispensable. If we didn't have that capability, we couldn't take that next step. So, I didn't foresee that in the beginning, but it certainly turned out to be that way in the end.

Hendrie: Did you have any particular innovation in the DSP world, that you started with that could get you product differentiation? Or was it more just that your customers needed DSPs, and you wanted to supply all the pieces through your company?

Stata: That was the top-level motivation, but then you begin to look for "Okay, how do you differentiate?" And we hired a designer from Motorola, who had done a lot of work there for Motorola, where the whole handset world was beginning to evolve in a very primitive way. And he had some insights about the architecture that would make it easier to do voice processing. So we added some things in one of our products that was attractive to the emerging cell phone business. So that gave us a hook of differentiation that sort of got us into the emerging cell phone market. And, on top of that, we had hired some software guys who had figured out how to do the voice coding. So we could offer, a package of a better processor and better software for voice processing.

Then, a second innovation which was more enduring, came again, from the bottoms up. One of our designers got the idea for an architecture for floating point that particularly addressed the needs of the most demanding customers in the military signal processing world. So we developed an architecture that was superior in that area. And it eventually became very important in audio processing in general and today is the leading architecture for pro audio processing. So you pick the places where, if your goal is to be the best and to succeed based on innovation, you're constantly looking for ways to do better than the competition. And typically, in the early days, we were a general-purpose product company. We didn't design products for particular customers or for that matter even applications, but we found that by doing a really good job for one application a lot of other people in other applications would want that, too. So a large part of our business was a catalog, a standard product business. That was our culture. It later got changed, but for the first 20 years that was our culture.

Hendrie: I thought we might stay on the product side for a little bit. Another product area that you became interested in was MEMS. Can you tell me a little bit about what your thoughts were on that and why you became interested in them? And you might even explain to our viewers or the readers of the transcript a little bit about specifically how you were going to apply them or what they do.

Stata: MEMS was totally a bottoms-up phenomenon. One of our engineers learned about work going on at universities about being able to make accelerometers using MEMS technology. I believe this was a professor at, it might've been Northeastern. But in any event, he got into that. MEMS is really a way of creating very microscopic mechanical structures on the surface of silicon. In the case of an accelerometer, if you could imagine a set of fingers cantilevered into free air and another set of fingers that were fixed. Whenever there's an acceleration or deceleration, the movable set of fingers would move with respect to the fixed set of fingers. And you would detect that capacitance change as a way of detecting acceleration or deceleration. So the whole thing about MEMS was to create those mechanical structures to sense acceleration. And the largest initial application for that was airbag crash sensors. So there were companies already manufacturing MEMS accelerometer sensors, but we had the idea of being able to do it better and cheaper, based upon the initiative taken by this particular engineer. So we worked at it. It looked like a relatively simple processing exercise. It was just a matter of etching different patterns. So we saw a way of making them better and cheaper by essentially integrating the electronics with the MEMS mechanical devices all on the same chip. Monolithically integrating it, that was the vision. And it looked like not that big of a challenge to do it, until we started doing it. Then we come to find out that when you make these mechanical structures really tiny, they behave poorly in the sense that they stick to each other, stiction. There's all kinds of little properties of these mechanical devices that you didn't anticipate. So we had to work our way through a huge long learning curve, to figure out how to do this. And so the plan that we had took much longer and much more money than we ever would've imagined, and the management, other than myself, sort of gave up on it. They said, "Look, this is costing too much money and it's taking too long. Let's do something else." But I got close to that group and understood what they were doing and all the problems they had worked their way through and decided, hey, we're almost home. You know, we just have one more leg of the journey to go, so I convinced the board and the management that we should stay the course, which we did. And that has now evolved into a whole new business.

Hendrie: And you were able to solve the problems?

Stata: Yeah, we did. We'd solved them. It took a long time, but the importance of that to Analog is that we had virtually no automotive business before this, and breaking into the automotive companies is very difficult. You've got to have something that distinguishes you in some way, and so the concept of being able to make an accelerometer for $5 versus $25, which is what they were paying for them, got their attention. And once we proved that we could do it, then we became a valued supplier, and now we have all kinds of things that we're selling to the automotive companies. So it wasn't just a matter of the sensor per se, but I saw that when it was brought to my attention that if we could do it, it was a way of getting into the automotive business.

Hendrie: Okay, so this was a product not dependent on the instrumentation business, which supported you for so long.

Stata: Well, sensors are part of measurement and control. And as a matter of fact, we look to the future, it turns out that sensors are going to be one of the most important drivers of new applications for the kind of business we're in, so that was just an early manifestation of that opportunity.

Hendrie: Okay, so what did you have to do to solve the problems? You said as they became very small they didn't behave the way they did when these MEMS were larger.

Stata: Right, right. Well, for example, we had to learn to put a coating on these mechanical structures to prevent this stiction. And that sounds easy, but developing the right coating, was a fairly long, laborious process. How to get the yields of the etched structures was another problem. How do we do that in such a controlled way that we get decent yields, and then on top of that how do you test these things? You know, there was a terrific development process of learning how to test them efficiently. The other thing is how do you handle devices that float in free space? In other words, for these things to move they've got to be in a vacuum where they can actually move. Typically, semiconductor devices are not floating around. They're nailed down and they've got coatings on them and so forth. Here you had to package these devices in ways that they could actually be mechanically free to move. So there are a lot of details about how do you get the die off the wafer when these little things are moving around and a lot of sophistication in terms of how do you handle these incredibly minute structures and not destroy them. So it's just a lot of good engineering.

Hendrie: Yes, exactly, not problems that necessarily require a breakthrough in science but just tough engineering problems.

Stata: And we're good at that. And incidentally, where are the applications that you never originally thought about? I mean today they're making millions and millions of these drones, and on those drones you need motion control, right? So our MEMS products are built into these drones these days. Who would've ever thought of that as a market.

Hendrie: Yes, you can't.

Stata: Right. So once you have a capability to sense motion more generally, lots of applications emege.

Hendrie: Okay. Are there any other technical areas or product areas that branch out of Analog's historic space, like the MEMS did, that we've already been talking about?

Stata: Well, for the first 25 years of our company we were pretty much in instrumentation-related areas. Then when the cold war was resolved, and peace broke out, the military and the instrument market, which largely was driven by military expenditures, slowed down. So, in the late eighties Analog had a major challenge/crisis in the sense that our markets slowed. At the same time, by good fortune, the consumer markets and the communication markets began to need the kind of performance that we could deliver. Prior to that the kind of products they had didn't need the performance that we offered. But beginning with the digital revolution in the consumer market things changed. The CD players needed 16-bit D-to-A converters, and we were one of the few companies that could make that kind of product. So the same thing happened with digital camcorders, right? They needed A-to-D converters to digitize the signals. So there was the digital revolution that took place in the consumer world that we see all around us today, that began to need our components. So that took us into new markets. It began to open up opportunities that we didn't see before. One of the earliest was cell phones and communications. All these markets required massive production compared to the instrument market. We weren't organized nor focused to be able to produce very high-volume products with very, very good quality. There was a lot more tolerance in the instrument market for failures than there is in the high-volume markets, and also the cost points are different. So we went through a period of transformation at Analog to become a high volume supplier and to go into the communication market and into consumer markets. So that brought us to one of the important product and technology developments in the company. That has been in the communications world learning to make RF circuits and learning to make converter circuits with sample rates that were needed for digitally processing RF signals. So today we have a very significant business in RF components and combinations of RF components with converters to make more complete radios. So for base stations, one of our big markets now is making more integrated components for radios in high volume and with very demanding performance. — We were in the converter business already, but there's all kinds of converters, and so we continue to push the state of the art in terms of the conversion rates to get what is needed to process radio frequency signals. So that's been an important development of the company, and then, as I said, increasingly RF circuits for mobile communications of all different varieties.

Hendrie: I didn't realize you did RF circuits.

Stata: Yes, and we're a major supplier to base stations. We were an early supplier to handsets. But then when the volume exploded the way it did, we would've effectively had to commit the whole company to handsets to keep up with the competition. So we actually sold our business and got out of that. But the technology was applicable to the base stations as well, except in much lower volumes and with much more demanding performance.

Hendrie: It meets the kind of things you do well a little bit better.

Stata: So that led to a change of our business positioning. In the early days, instrumentation, measurement and control, and data acquisition was how you would identify the company. But as we got into DSP, as we got into communications, we say we're really more broadly in signal processing, right, of which measurements and control is one aspect. Mobile communications is another aspect. So now the company is positioned to be a leader in the high-performance end of real world signal processing. So we've redefined our company to open up broader vistas of opportunity but still in a way that's consistent with our roots.

Hendrie: I'd like to talk a little bit more now about some of the organizational changes and history of the company. I know you got started very early in Ireland. Tell me the Ireland story.

Stata: That grew out of our converter business. When we first started making converters we used bipolar technology. In converters you need some elementary logic and you need switching, as circuit requirements. And we fudged those up in analog form and were able to make products for converters that way. But a better way to make them is with CMOS, in terms of the logic density you can get, in terms of the switching characteristics, and in terms of interfacing the converter with the outside world. The output of converters go into a digital world, right, so you need a digital interface. So it turns out you really needed CMOS technology. Not the kind of digital CMOS that they used for microprocessors and high volume digital circuits but CMOS which had higher voltage characteristics and so forth that are specifically aimed at solving the converter problem. So we came to recognize that the technology we had for making our historical analog components was really not a good technology for converters. So we had to go on the hunt and figure out how are we going to get CMOS technology. It requires a whole different fab. And, we were still a relatively small company, we couldn't afford another fab. What were we going to do? So one of our best engineers went to California and we formed a joint venture with a company called Micro Power Systems that not only had CMOS but also had thin film resistor technology. It was actually from them that we learned the thin film technology that we used early on. So in his relatively small pilot foundry we made our first CMOS converter products, and they worked beautifully. Now we had to make them in volume. What do we do now? So we went to Ireland essentially because they would buy equipment, train our people, and there were these subsidies that the Irish government would give us to set up shop there that were very substantial. So, therefore we could afford to do it. Otherwise we were stuck. We couldn't get the foundry capability that we needed. So, the guys that were in California, a team of five engineers, went to Ireland, set up the first integrated circuit facility in Ireland which became enormously successful.

Hendrie: What year was this?

Stata: That was in 1976. So we not only set up a fab but we also had a culture where the engineers and the process guys had to be within walking distance of each other in order to innovate and to learn from each other how to do it. So we not only did manufacturing there but we did the circuit design. And on top of that we also had to figure out how to deal with the customers so we set up marketing. So we were one of the first companies that had an integrated business that did the manufacturing, the design and the marketing, right? As a result of that we were able to hire the pick of the litter from universities. I mean in Ireland Analog Devices was king. Here in the US we had to compete with IBM and Hewlett Packard, but in Ireland we could hire whichever students we wanted, so we were able to hire very talented people and over a period of time build up a very successful business. A lot of those very talented people grew up and matured in Ireland and there wasn't room for them there, so they began to go to Analog operations in other parts of the world. And today we have out of, say, 25 vice presidents of the company, I think 19 of them came from Ireland. So this turned out to be not only a very successful business development but also a very successful human resource development exercise. **Hendrie:** Now did you also help support the educational infrastructure in Ireland where your plant was?

Stata: Well, we had a very unique relationship with the University of Limerick. This is on the west side of Ireland, which was the least developed side of Ireland. The university there was just getting started. It wasn't even called a university at the time. So we worked with them very, very closely to develop the course materials, to essentially have a pipeline of people who were educated and ready for work at Analog. We did this through a co-op program that they copied from Northeastern. So we had the students on work-study programs, and by the time they graduated they were ready to really do important work. So it was one of a handful of decisions at Analog that made the difference and the success we've had in that country.

Hendrie: That's very good. So in the early days you of course were based here in New England but did setup a design center in England. Then later, as you said, you acquired a company in California. And then you hired an engineer in England though that was obviously much later. But talk to me about how you made all these organizations work together.

Stata: Well the organizations were differentiated by technology, so in Wilmington we made bipolar circuits, right? In Ireland we made CMOS. We acquired a company in North Carolina that made very sophisticated hybrid circuits because monolithic integrated circuits didn't have the speed characteristics that we needed.

Hendrie: What was the name of that company?

Stata: It was called Computer Labs, and it was started by two engineers at Bell Labs who had essentially invented pipeline converters. They were the guys who did that at Bell Labs. They left there and they set up this company in North Carolina, and after some number of years of watching their spectacular performance and growth I convinced them to join Analog Devices.

The organizations were differentiated by technology. And, as I said, we felt that if you've got the process manufacturing people and the circuit designers and the marketing guys all in the same room you can do magical things. If they have to travel across continents to meet each other it slows the process down. So we were focused. We organized the company around technologies and we gave all the resources it took, in that organization, to do their thing; the administration, everything. So we were highly decentralized in all these different groups that we had. But then came the convergence of technologies. All of a sudden bipolar and CMOS converged into BiCMOS, so that the differentiation of the factory in Wilmington and the factory in Ireland began to blur. At the same time, we got into the high-volume manufacturing business and discovered that these little fragmented fabs that were good for making low volume, high performance parts; were not so good for making high volume parts. So another major shift happened in the company when we got into the high volume markets and the technologies converged. We centralized manufacturing and we created worldwide product groups. Before that the converter designers in Ireland competed with the converter designers in Wilmington and competed with converter designers in North Carolina because their products were all made on different technologies. But as the technologies converged we needed volume, so we centralized manufacturing. And then we created worldwide product groups, like a worldwide converter group, so the guys that used to be enemies and competitors were now collaborators. The difficulty was the engineering managers, back in those days, believed that you could not manage an engineer unless they were within walking distance of your desk. So the whole idea that you could have people working across continents was a new invention. I mean today it's commonplace, but back in those days it wasn't commonplace. And the idea that a division manager could be held accountable for profits who didn't have his own fab, right, was a foreign idea. Today it's not such a foreign idea, so we had to break those cultures and completely change the beliefs about what was important to success.

Hendrie: Okay. So you did this, not by trying to move organizations, but by combining them and having the management responsible for people in multiple locations. So it was a reorganization of management responsibilities as opposed to moving people around.

Stata: Right, right.

Hendrie: All right. I have heard that there was another phase in the organizational growth of the company where you started to move toward a focus on markets. Could you talk about that next evolution?

Stata: Yeah, that's a work in process as we speak. We were born a component company as were most semiconductor companies, and so the customer would buy the bits and pieces and they would do the systems design integration on a printed circuit board. As it becomes possible to integrate more and more of these functions on a single chip of silicon, most customers don't have the ability to do that integration of design nor do they have the desire. I think there's a change in the marketplace today, driven mostly by economics and by where the expertise is, to where customers who used to want to buy components don't want to buy components anymore. They want to buy systems. So now our products have to become more focused on the needs of particular market segments. What do guys need in medical? What do they need in base stations for communications? What do they need in automobiles? And there's always been those distinctions, but the customer absorbed that differentiation. They bought the components and they built the systems. Today we have to become more expert at what goes on in each of those segments and deliver them more complete systems where we're doing more of the systems design. So one more time we need an organizational change. I initially it was technology focused. The next wave it was product focused. The next wave is market focused. And so, we're now in the midst of restructuring ourselves to become much more expert at delivering solutions that are market and application specific.

Hendrie: Yeah, okay. I think maybe the next question I'd like to ask is if you could tell us the story of your transition from running the company you started to where you are now, which is clearly involved but not in charge.

Stata: Right, right.

Hendrie: So that must've been difficult. Talk to me about that.

Stata: Well, I mean the good news part is the people who run the company today have been here forever, so they understand the culture and they understand the business. I have a lot of confidence in them, and that was true of the former CEO as well, who passed away very suddenly and unexpectedly. So at least it made it comfortable knowing it's in good hands. But beyond that, when you've spent your whole life wanting to be in control of your destiny as your goal and you've created this-- or helped to create this thing, you know, not being able to have the influence that you had most of your life is a painful transition from that point of view. You just sit back and grin and bear it and see things going on that in small ways are not how you would do it, so you've just got to get used to it.

So what I did, I've always worked very hard and used up most of my time in professional activities at work. I started essentially a small venture firm, and I live vicariously through working with others who are doing what I did. And there's a certain amount of enjoyment and satisfaction to that but not as much as if you <laughs> had your hands on the knobs. So that's the way it is. I don't have any regrets. I mean I know that in a lot of companies, leaders choose not to do that, but I think that's very selfish to just cling and not let a company grow through other dimensions and other experiences. I mean it's got to come to an end someplace, and it's better, I think, being a little earlier than later.

Hendrie: Good. Maybe you could talk a little bit about when it crossed your mind that maybe you ought to think about a transition and who you had that you might feel comfortable with.

Stata: Well, the person who became the CEO, Jerry Fishman, had been with the company forever, 30 years or 27 years or something.

Hendrie: What area had he been responsible for?

Stata: He was more the marketing strategist/operational oriented person, not a technologist, per se, although he had an engineering degree and he understood the technology of the business. But he was more of an optimizer of what we had than necessarily somebody who's pushing into new frontiers. On the other hand, I think there was a lot of room for optimization of what we had and he did an extraordinary job of that, and we needed that. That's why I'm saying that I had my way of doing things and strengths that I bring to the party. The CEO that took over for me had his strengths, and now we have another one and he's got his strengths, and the company is richer by that variety of influences.

Hendrie: Yes.

Stata: Now as to when did it occur to me?— Jerry Fishman was heir to the throne for quite a while.—

Hendrie: So you had raised him up in the organization to have a significant amount of responsibility.

Stata: Yeah, he became the president.

<brief interruption>

Hendrie: All right, yes, please continue.

Stata: So Jerry was the heir apparent and had been for a number of years. He was elevated to the position of president. A lot of the responsibilities of the company were already on his head, and I think he grew in stature and strength as time was moving along and, frankly, one of the issues in my mind was that at some point if he weren't given the reigns he might be tempted by some other company that would, and I think that would've been a tragedy. So part of the motivation was to give him his opportunity to do his thing and to not possibly lose him. I never had that threat from him nor was that a discussion that we had ever, but it was a discussion in my own mind.

Hendrie: Well, that is very prescient of you. Actually, I knew Jerry because he was on a board that I was on, and in fact, we had a conversation about that while he was still president. And he was thinking sort of like, "Oh, you know, maybe I ought to be doing something else." So he was thinking about it while you were thinking about it. Very interesting. So eventually you did the transition with Jerry and then he passed away. What happened then?

Stata: Well, it was just a totally unanticipated heart attack on top of another heart attack shortly before, and it just was a big surprise, an unexpected tragedy, just totally.

Hendrie: Now was there somebody whom Jerry had sort of started to groom?

Stata: Yes, I think not with the same organizational visibility, shall we say, that Jerry had. But Vince Roche had been cultivated and prepared, and there were discussions going on with the board as to when would be the right time. Perhaps that time was growing nigh because of the same concerns, right, that perhaps he was getting a lot of visibility and he might decide to move on.

Hendrie: What area was Vince in at Analog?

Stata: Well, he'd been here for 27 years, a long time. He was part of the Irish group.

Hendrie: Oh, okay. And so what was his responsibility a few years ago? I'm interested in what kind of responsibility he had. What was his specialty?

Stata: Oh, I see, yeah. He had product line responsibility at one point in his career, and then he became head of worldwide sales, and then he became head of the verticalized organization that we'd spoke about earlier. He was operating pretty high up in the company as far as strategy and customer relationships in terms of where the company was going. So you never know. I mean there's always questions about everybody's ability to provide leadership, but he has just been amazing in terms of how quickly he's grasped the reigns and is providing tremendous leadership to the company. It's great.

Hendrie: That's excellent. All right, you had started to talk about your venture capital ventures. How did that get started, or had you been doing that in some sense all along? You talked about how you started the semiconductor company, which in some sense is a foray into that world. Had you done anything before?

Stata: Well, I mean in many ways I look at what I did at Analog was kind of like a venture manager, deciding what areas to invest in and managing the startup processes of those entities, protecting the fragility of new activities. I mean that was the part that I brought to the party to a great extent. And so I had a lot of experience with that and knew about it, and I was just practicing it <laughs> in a different way. So I actually had, even when I was the CEO of the company, made a few investments here and there but not to where I got involved personally with the effort. But in any event it wasn't a new experience, and it's a part of the business that I enjoy the most; that is, finding new things, making new things happen and breathing life into new things. That's the part that's exciting to me. And so as a venture capitalist, you have a chance to see a lot of new ideas and to meet with and work with very bright people, so it's not quite as good as having control, <laughs> but it's as close as you can get.

Hendrie: Do you mostly invest your own money or did you raise money from limited partners? Also did you bring any partners in to help run the venture business?

Stata: In the beginning it was really just family money, and then at some point there's one investor I knew, a very wealthy man, and we had an opportunity to have access to some of his funds. So we did bring in another person as a partner into the venture business but continued to invest the family funds as well.

Hendrie: are there any particular investments that you're particularly proud of?

Stata: Yeah. Well, I think there's one, Nexabit, that made a core router, and that was bought by Lucent right at the top of the bull market in the late 90's before it'd ever been put into the field. So I was proud of that because, number one, it was a breakthrough in innovation in terms of how to build routers though, unfortunately, it was never put into practice. And number two, it was a tremendous return on the investment that I made. Lucent paid $900 million for the company <laughs> and never actually finished the journey.

Hendrie: Wow.—

Stata: So that was one. There was another company called Voice Signal Processing that came up with a very small footprint in terms of computational requirements for speech recognition, and that got built into a lot of the cell phones and, again, was sold for a good sum of money. But that was a very innovative technology that worked out well. And there's another company that's a spin out of MIT that has a flexible hollow-core optical fiber technology to carry CO2 laser energy noninvasively throughout your body. Normally CO2 wave length is line of sight, but this fibre had a hollow air core and some technology around how you contain the photons within that core that allowed you to do noninvasive surgery.

Hendrie: What was the name of that company?

Stata: It was called OmniGuide. That I think is going to change a lot of different opportunities to do surgery, and for that I'm proud. From the point of view of making money that wasn't one of my winners, but nonetheless I think it'll go on in the world and do good things. So there's been a number of interesting companies.

Hendrie: Okay. Were there any particularly big disappointments?

Stata: I don't think of any that withstand close inspection.

Hendrie: All right, good. Well, certainly Nexabit was amazing. In my venture world I actually looked at Nexabit with Paul Severino, so I know a fair amount about the technology. Yeah, we met with the founder, and it was a very clever scheme that he had.

Stata: Yes, it really was, and it's a shame that it's not out there in the field working today. It solves a lot of problems.

Hendrie: All right, now I'd like to discuss just a little bit about your philanthropic interests. But before I do that, you had mentioned earlier that you developed an interest in music early on. Maybe you could tell me just a little bit more of that story of when your interest started, because certainly you've been philanthropic with musical organizations, which we'll get into.

Stata: That was somewhat accidental. I mean I took piano lessons, as most people do, but never learned to play the piano.

<laughter>

Stata: And I never thought of myself, when I was younger, as being particularly all that interested in music, until I heard the theme song from “The Outlaw,” a movie that starred Jane Russell. I think that movie was mostly notable because of Jane Russell, but in the theme music they used the music from the Tchaikovsky’s Sixth Symphony, the “Pathetique”, And that just struck me as being such incredibly beautiful music. I went on a search to find out who had written that and what did it mean. And, fortunately, my English teacher in high school, I was a sophomore then, said, “Oh, yeah, come to my apartment and listen. I’ll play the whole thing for you.” And then she started loaning me records from her record collection, and all of a sudden the world opened up to me with all this incredibly, incredibly beautiful music. So it began then. I used to listen to the “NBC Symphony Orchestra” with Toscanini on Saturday nights. I would never miss those broadcasts. And the first place I went when I landed at MIT was to the Boston Symphony Orchestra student concerts. I went there the first time they were open. And I have always just loved, not just classical music, but Greek music--now I’m married to a Greek--and Irish music and folk music of all types. But in particular the great masters give just an incredible richness to life, when you come to learn that music.

Hendrie: Maybe you could talk to me about when your philanthropic interests or inclinations started to develop. What were the earliest things that you decided you’d like to help?

Stata: Well, certainly, MIT had an incredible impact on my life in terms of giving me the self-confidence for going out into the world and being able to compete. I think when you live in an MIT environment, even if you’re not amongst the brightest, at least you know who they are and how they operate. And so developing the feeling that you could compete with very talented people was an important development, apart from what I learned there. And so that allowed me to pursue a career, and I have been successful at that, and so I’ve always felt this debt of gratitude to MIT, particularly because I didn’t have the means myself to attend. They provided that. They said, “Don’t worry about it. We’ll take care of you,” which they did. And I just feel that as I’ve gotten to know higher education and MIT in particular, the future of these institutions very much relies on the alumni. They have to carry a lot of the weight in terms of the financial burdens of financing these places. So once I understood that, then that was an early target to support, and the same with the BSO. I mean those places depend on the generosity of their audience to continue having that music available for future generations. So I funded a chair for the second bass initially and then later on I funded the music directorship there.

Hendrie: Yes.

Stata: And at MIT I contributed to the new computer science and electrical engineering building, designed by Frank Gehry, the Stata Center. So I was instrumental in making that happen, not that I financed it all myself by any means. But at least I got the administration at MIT to finally, finally after 30 years <laughs> bring the computer science part of the faculty and the EE faculty together in one place. Before they had been separated across railroad tracks with infinite complaints by the faculty to please fix this. So I challenged the administration and said, "What would it take for you to make that a priority?" And they mentioned a number that was ridiculously low and I said, "You got it." And it turns out by the time it was all over it was more than that, because the ambitions grew as to what it meant to integrate these things, but we ended up with the Gehry Building and all the wonderful things that has brought to the MIT campus.

Hendrie: Well, it certainly is a wonderful thing to have that building there, and also it's sort of an architectural statement, too, in addition to serving its real purpose, which is to integrate the faculties. Had you done any other things for MIT before that, because that was relatively recently?

Stata: Yeah. I was on the visiting committee for EECS for 18 years, I think it was. I became the chairman of that committee, and that's where the notion about fixing the problem of bringing two sides of the faculty together came from. But then I was invited to be a member of the corporation and from that a member of the executive committee, so I served quite a number of years in those capacities. And in those years I made other contributions of various sorts along the way before we got to the Stata Center.

Hendrie: Okay, did you support any professorships or any prizes or anything other than just general alumni giving? I'd be interested in what the targets were and why you chose them?

Stata: There were a number of things of a nontrivial nature that I funded, including a name professorship.

Hendrie: Yeah, okay, I'm not going to make you run down them. You don't have to talk about them if you don't feel comfortable. On another note, I understand you were very involved in the search for a new music director/conductor at the Boston Symphony Orchestra to fill the position you had already endowed after Seiji Ozawa retired. Could you talk a little bit about that?

Stata: That was when James Levine, music director of the Metropolitan Opera in New York City, became the music director of the BSO. I was on that search committee, which was quite an educational experience. The committee is made up half of musicians and half of the membership of the board of trustees, and to have an opportunity to see what the professional musicians look for from a music director and what are the qualities that they bring to that party was very interesting. A lot of people think of the music director as he just gets up and waves the wand and that's the end of it. But I got a richer, deeper understanding of how you distinguish between what this one brings and what that one brings. And a lot of that learning came through the knowledge of the musicians that were part of that search committee. And so we got a good one. I think Levine brought a lot to the orchestra in terms of the new hires that he was responsible for bringing in. It changes the character of the music, so it was a good choice.

Hendrie: Okay.

Stata: I was not on the search committee when Andris Nelsons was selected to replace James Levine, when he stepped down. I had been retired, by virtue of age, from the trustees when that happened, but we got another winner.

Hendrie: Yes, I agree with that, being also a Boston native. Now you also spent some time with the Boston Lyric Opera. How did you get involved in that?

Stata: Well, my early interest in music was symphonic music and chamber music, and it was only later in life that I got to appreciate operatic music. And it's just a lot handier <laughs> to go to an opera here in Boston than to take the train to New York to see the Metropolitan Opera. So, therefore, we went to several of the operas, and year by year they've gotten stronger and stronger. But there's a conviction on the part of a lot of people, including me, that for Boston to be one of the major cities of the next 50, 100 years it's going to have to have an opera house or a more permanent home for their opera because it's just such an important part of the fabric of a great city. So we're still struggling with that and I think we haven't got the solution to it at this point, but hopefully in the future we'll have an opera house.

Hendrie: Okay, very good. What other areas in your career do you think that I've forgotten to ask you about that you might want to comment on or you think are significant?

Stata: Well, I don't know. I've led a relatively narrow life in the sense that growing and developing and living through all the cycles of development at Analog has been a very challenging experience, and the part of that which I probably most appreciate is the pressure that it brought on me as a leader. To continuously upgrade, improve my skills, my leadership, my knowledge of what it took to lead a company of larger size and complexity required continuous learning throughout my life. And so, apart from the fact the company's been successful in many other ways, for me that's probably the greatest contribution. And it turns out, as I look across the company, perhaps that's the thing that I was the most proud of.

I could never have imagined <laughs> 40 years ago that I could've ever been able to handle the responsibilities of the CEO of a billion-dollar company. And so it is for a lot of the young people who came to Analog Devices. To see them grow and develop into really mature, world-class executives and engineers and leaders has been a very important part of this experience. And one of the reasons I'm so enthusiastic about capitalism and business enterprise being such an important part of the American and the world experience, is not just the economic aspects of it, but the challenge and the opportunity for people to develop to their full potential and deliver at a level that without that kind of structure just would never happen. And the benefits that emanate in the world are very, very important. So, I'm very proud to be a businessman, to be part of that heritage, to have been part of that contribution. And to me it's sad for those who really don't understand that, to denigrate business and the business community as being something less than what it is.

Hendrie: Okay, very good. My last question is what advice would you give a young person who's interested in science and math in terms of looking forward to their career?

Stata: Well, I'm tremendously biased there. I only see the world through the lens of experiences that I've had, but the education that one gets in science and engineering, particularly engineering, in terms of problem solving, and a depth of understanding of kind of what's going on in the world is invaluable. So much of the world is technically driven these days that it's just a wonderful place to start your career even if you're going to go on to do things other than engineering, so I'm very high on that.

The other part is that in terms of education it's not just about the technology, the bits and the bytes and the holes and the electrons. The educational process in the university is the development of the whole person and their understanding of the world in broader terms. In particular it is about who human beings are and their behavioral aspects and how that ultimately fits in to being able to work and provide leadership and participation with others to get important things done. That is a very important part of that educational process. And for me, what I learned in the humanities, and in particular in the courses in philosophy, triggered my interest in that world. That interest has continued through my life in terms of understanding where we came from and how we got here and what are the ideas that have brought us to this place and what are the alternatives and options. That's a very important part of education. I'd say a place like MIT is not known for that, but they do a remarkable job in developing the whole person, and for that I'm very appreciative.

You know, going back to other interests and where I've spent time, I've been concerned about the perennial shortage of technical people, engineers, here in the United States. I've always taken a particular interest in trying to find ways to enhance engineering education and attract a larger number of people into the engineering education fields. So that's been a particular thread of interest and development over my whole adult life that has now extended into K through 12 education.

I'm also interested in what goes on in the inner cities, and the importance of education in lifting people, providing opportunities for them to make the most of their lives. That for me is another place I do spend a fair amount of time and have a great deal of interest, in terms of what's going on in the world today and what isn't going on in the world today, here in the United States and elsewhere.

Hendrie: All right. Well, thank you very much, Ray, for agreeing to do this oral history for the Computer History Museum. We're very appreciative of your time and your willingness to do this interview. Thank you.

Stata: Well, it was a pleasure, and thank you for being a great interviewer.

Hendrie: All right, thank you.

END OF INTERVIEW

