Oral History of George Scalise

Interviewed by:
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David Laws: It's Wednesday, January 27th, 2010. We are at the Computer History Museum in Mountain View, California and this afternoon we're going to interview George Scalise, who is currently President of the Semiconductor Industry Association and has a long and distinguish career in the semiconductor industry. Let's jump right in. Can you tell us where you were born and a little about your family background?

Scalise: Thanks David. I was born in a little steel town in western Pennsylvania, Warren, Pennsylvania, north of Pittsburgh. I guess there were two things that distinguished that area. One was that oil was discovered in t nearby, in Titusville. The Drake well was about 25 or so miles from where we lived In Warren. And therefore, there were a lot of oil fields when I was a young boy. Most of them have now dried up; there's not much of it left but there's a little. And then there was the steel fabrication business, which was the main industry in Warren. It wasn't the processing the steel but the fabrication of tank cars, railroad cars, tank trucks and all of the things that use steel. So, it was a very prosperous area at that stage. And as a result, it was a destination point for a lot of the immigrants coming from Europe. My father came from Italy and originally went to work at Cornell University as a gardener. And like many of his colleagues, he came from the south of Italy. They had migrated down to this part of Pennsylvania because there were a lot of jobs there. He worked in the steel fabrication business all his life. It was a great life. Those small towns, 15,000 people, they never got bigger. They never got smaller. They just stayed about the same. It was a place where you could really grow up and live life as a young boy doing all the things you want to do. There weren't very many constraints and there weren't many things you could do either but it was a very good life.

Laws: What year were you born?

Scalise: I was born in 1934, right in the middle of the Depression. Although I don't remember a great deal about it being that young, there are many aspects of it that still come back as you think about how the late years of the Depression; well, from the middle to the end of it. About seven years or so. It was a very difficult time. I would guess my father probably worked on average a quarter of the time. That was about it. And the rest of the time, he would be out trying to get jobs mowing lawns or whatever else you could do. That was like everyone else as well. So, from that standpoint, I learned a lot during that Depression Era. I guess a lot of that probably stuck with us as we grew up and as we handled our finances and our careers. There was a backdrop there that most of the young people of today have not had and let's hope and pray that no one ever has to experience that ever again. The big plus for the period was a sense of community and trust. When you went to the grocery store or meat market, you could always get what you needed and then you would pay when you had the money. No one was turned away.

Laws: Was your mother from the same immigrant background?

Scalise: Same immigrant background. Her family came from the same area where my dad came from. She was the [youngest and the only] one in her family who was born here in the US. But it was a town where you had a lot of Italians in one section, a lot of Polish in another section and the Swedish in another section. But it was only 15,000 people so the sections were small. They're just a few blocks. But that all quickly became a part of the melting pot we've heard so much about. It all came together as we grew up and there wasn't any difference as time went on. Schools were quite good. The teachers

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were so dedicated and even though you didn't have nearly what we have today in the way of teaching aids and computers and Internet. There was still a very effective teaching process and the dedication of these teachers that really was quite successful. As I think back and think about the school years, I guess you always felt good about going to school because it was just a good experience. And the teachers were capable and dedicated. They worked with you. You were able to learn to the extent that you were capable of learning. I think that was something that made a huge difference in our lives. So when the time did come to go beyond high school and into college, in spite of being from small schools in a small town, you still had a very solid background in mathematics, physics, and chemistry; again as it was taught at that stage so that when we got off to school, it was a pretty good experience. In fact, one of the few benchmarks I have with regard to that is the chemistry program at Purdue. I went to Purdue University Engineering School. They had a series of entry tests to see where you could fit in, in your first year. I was put in Advanced Chemistry and actually was taught by Professor Martin who was one of the key technologists in the Fermi Program at the University of Chicago. So, that gives you some idea of what the school was capable of doing to bring us along and prepare us for college. So, it was a very good experience living in Warren.

Laws: Was it a particular individual or family member that influenced your interest in science and engineering?

Scalise: Well, not really. I think as I came along, having come out of the Depression and knowing that if you're going to succeed in life, you had to find something that you were both interested in and perhaps could be good at. And then you'd ask the next question, which is which ones provide the best opportunities for you? And engineering continued to come out of that. Now, the other thing that was really interesting when I got to Purdue--

Laws: What year did you go to Purdue?

Scalise: I went to Purdue in 1952. I graduated [from High School] in June and [entered Purdue in] September. But what was interesting about that was that you had to declare in your first year at that time because you had some basic course requirements. But then at the end of the year, you had to go to summer school for a month to [take courses in your chosen discipline]. In the case of Mechanical Engineering, which I chose, you had to work in a foundry. You had to tear down an automobile engine and then make it work once again [when re-assembled]. There were a number of these very practical jobs that you had to take on and that were a part of your basic training. But before you made that decision, the question to ask, which one do you want to go into? What school? And my question back was which school gets the most job offers? The answer was mechanical Engineering so I said, "Okay, I'll be a mechanical engineer. I think it's interesting because I've now come to the realization that it really doesn't matter too much which engineering discipline you select. As long as you pursue it aggressively and you do well, it really teaches you how to think and solve problems more than anything else.

Laws: It's the process.

Scalise: It's the process.

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Laws: It's not just the information that you get.

Scalise: Yes. And the rest of the information that you and I learned over the years; some of it being electronic, some of it being advanced physics, what have you, was built on to that foundation that we got in engineering school. So, I've always been grateful for that process working as it has and the opportunity that it's created and provided to those of us that chose it.

Laws: You graduated in 1956?

Scalise: '56 from Purdue, yeah.

Laws: What was your first job? How did you select it?

Scalise: Well, my first job right out of school, at that stage TV was becoming a big thing. Not too big yet. I went to work for Sylvania in their TV division out of Buffalo New York. They had a manufacturing plant in Batavia. And I was located there. Within a month, I got my notice to go take my physical for the draft because the draft was still a part of the process at that stage and while I was in Harrisburg taking my physical I thought, you know, my four brothers-- because I have a family of four brothers and one sister and I was the youngest boy. All my brothers had been in the military during the later part of the Second World War and then to Korea. And I said "I can't be the only one in the family that doesn't go into the military." So, while I was down there, I decided I was going to volunteer for the draft and go in the army for two years. So I did that. Came back, to the surprise of my boss, told him that I'm going be leaving in a couple months to go in the army; even though I just started the job but I just had to do this. So, I did. And I spend two years in the army, in the Chemical Corp of all things, making munitions, which were probably the most-- I don't know what the best word [to describe it] is. But chemical munitions, there isn't anything good about them. They're just a terrible, terrible weapon. We didn't have a very good methodology for determining whether or not these leaked and how we would treat them in the event that they did. It was a very, very difficult time. But again, I learned a great deal about the importance of engineering and engineering something very well. And the more toxic it might be, the more important it was to do it very well. And we did. I mean, making landmines and shells and all kinds of weapons, it was a very interesting experience. But [most importantly], I learned about the engineering of a product and doing it right.

Laws: Did you have any choice of what you were assigned to in the army?

Scalise: Once I got through basic [training], that's where I was assigned and I was in it for two years. Yeah, working as an engineer, which was really a good thing for me because I got a chance to do a lot of engineering work while I was in the army. So I satisfied two needs that I wanted to get out of the way.

Laws: When you completed your tour of duty, what year was that and what job did you go to?

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Scalise: That would have been in ’58. I went in October of ’56 and came out in October of ’58 after two years being at the Chemical Center in, Edgewood, Maryland. When I came out, the semiconductor industry was just getting underway. I went to work for a company called CBS Hytron, changed eventually to CBS Electronics. It was the Columbia Broadcasting System who decided they wanted to branch out from broadcasting. At that stage, they were a very large producer of records. And they wanted to get into high technology so they bought the CBS Hytron Factory, which was one of the factories that was established during the Second World War to provide tubes for the needs of the military. I went to work as they had just started their semiconductor operation.

Laws: Where was that?

Scalise: That was actually located in Lowell, Massachusetts. It was in a little old mill building. No air conditioning. In the summer, the windows were open, everything blowing in from the dirt parking lot.

Laws: Not exactly a clean room.

Scalise: Not exactly a clean room. Not quite what you would think of as a clean room today certainly. I went to work there where we were making alloyed-diffused devices. Everything was germanium at that stage. Germanium transistors, alloyed diffused. We were also making germanium diodes. Actually at that stage, we made a diode, a point contact diode. It was called a plastic diode because it housed in a plastic sleeve... It was made with a hammer, believe it or not. What we would do is form a junction on a pellet. We would solder that die to a pin. Then solder an S-bend to another pin. And we would slide these two into a plastic sleeve and we’d connect them to a curve tracer. Then we’d tap them until we got the right forward characteristic. When we got there, we would stop and we had the diode. Now, you and I know that with temperature and handling the characteristics would change a bit; quite a bit in some instances. But it was the best we could do to make a diode at that time and it was okay for transistor radios. Because the radio was one of the early users of transistors, especially power transistors and diode it was a good business

Laws: What was your role?

Scalise: Well, I started out in facilities. Because we didn’t know how to treat water I was given the job of putting together a water treating system and provide the kind of clean water we needed for rinses during the manufacturing of devices. We developed a very good water treating system using sand and carbon filters and demineralizing towers. We didn’t do reverse osmosis at that point. That came along later. Then I went from there into some process work and began to get more involved in how we would develop processes but it was very fundamental. It wasn’t very sophisticated because we didn’t know quite where we were going or how we were going to do things. It was all so new and there weren’t any recipes for us to work from. But what also happened in parallel with our work CBS became aware of how difficult this business was and they weren’t prepared to invest in it as much and as long as they were going to have to, to make it a success. So, within three years, they decided to get out of the business. They were selling it to Raytheon. One of the hopes I had when I first came out of college was to be an engineer for a period so I could learn the technology and the business. My first goal was to get an MBA and become an investment banker. I thought that would be a good thing to do. So, I started my MBA work at Boston University, I was going there at nights when CBS decided to get out of the business. Of the 400 people

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we had working at CBS at that time; six of us were selected to stay. Everyone else was laid off. The six of us could go to Raytheon. So I thought about it really pretty hard and thought, "Well, it's not quite what I want to do but maybe if I do this, I can finish my MBA and then I'll go on and do what I want to do." Well, the last day, Friday, that it was still CBS; Monday it would become Raytheon I was walking into my little apartment. And remember, we didn't have any answering systems for our phones then. If you weren't home when the phone rang, you didn't get the call. I just happened to walk in the door as the phone started to ring. So I walked over and picked it up; and on the other end was a fellow by the name of Harry Knowles. He was calling from Motorola in Phoenix, Arizona. Harry said he had heard about me and heard some good things and wanted to know if I would be interested in coming to Motorola. I said, "Well, we've been shutting down this operation for three months. I'm really tired of that. I have to get back to work. I want to get back to work. So, I don't think so." So he said, "Well, listen. Will you come out tonight and talk to me." I said, "Well, if you can get me out there tonight, yeah, I'll come out." So he said, "Hang up." He called me back in a few minutes and said, "You're on a 6:00 plane from Boston to Phoenix." I'd never been past—I don't know where; Chicago, by that time. So I said, "Okay." So I ran down to the airport, got on this plane.

I get into Phoenix and again, at that stage, Phoenix is really a pretty small place. Harry meets me at the plane. We go to the factory. By this time, it's probably 8:00 or 9:00 at night. Well, Harry was a brilliant guy. He's one of the smartest guy's that I've ever met in my life. He was one of the team at Bell Labs that developed the germanium mesa technology and he was head of R&D at Motorola. We spent until 3:00 or 4:00 in the morning in the factory going here, going there, doing this, doing that. Having chats about everything. And finally at that stage, he said, "Okay, are you interested?" I said, "Yeah, I'm interested." He said, "All right. You go to bed. We'll meet at lunch tomorrow and I'll have an offer for you." Now that's the way you did things then. You didn't go through 16 interviews with ten different people. Whoever is hiring you, interviewed you and they're the ones who hired you. That was the deal. And so I got the offer letter from him at lunch. We had a nice lunch. I flew back to Massachusetts. Packed what few things I had into a few boxes. On Tuesday I'm on a plane on my way back to Arizona. So, it's one of those remarkable things that happens in life that changes your life because it would have been a whole different path had that not occurred.

Laws: What was your initial assignment at Motorola?

Scalise: My initial assignment was to help Harry run the research effort. Harry, as I said, was a brilliant guy. He needed someone who had that skill set, to get along with all these engineers and to manage the programs. My job was to make certain that when we weren't making any progress on [given] path, to divert and get on to [a new track]. Harry was so smart that he was always coming up with new ideas and we always had to kind of shift him to the side and not get in the way of what we were already working on. But you know how these guys-- You've worked with guys like this; they have an idea a minute and you have to be capable of sorting out the ones that will probably l work better than the others, because they aren't going to do that. They're going to pursue everything because that's the way they think. Harry was one of those guys. Brilliant. Harry was one of the great influences on my career.

Laws: You were a program manager in some ways for the R&D projects.

Scalise: Program manager. Right, right.

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Laws: How long did you do that?

Scalise: Well, just about a year, year and a half probably. We were developing the integrated circuit process and as we began to get to the point where we needed to get that into production, I was given the job of taking it from research into production. And so I spent the next few years building up a manufacturing capability and developing the early products. In the first instance, they were still hybrid. They weren't fully integrated. That came later. Building the equipment, designing and building the equipment that we needed for manufacturing. I remember the first bonders, Les Hogan and I were on a trip Western Electric when we heard that Fairchild was going to go to Hong Kong. They were going to have lower cost manufacturing by going to lower cost labor.

Laws: That was about '63 or '64?

Scalise: Yes, around that time. Around '63, '64. So we talked about it and I said to him, "We don't want to do that yet." We were on this trip to go to Western Electric to take a look at this bonding machine that they had come up with. So I said, "Let's go take a look at the bonder and see if we can build it. If we can make product cost competitively using a wire bonder with their manual technology then we'll move that overseas and we'll really win the race." So that's the approach that we took. We went saw this bonder and concluded, "We can build that." Licensing with Western Electric at that stage was a given. We had a good machine shop and design group for so we licensed the technology and we built a bonder. It wasn't very good to begin with because feeding the wire and having the right gold wire alloy took a while.

Laws: This was gold ball bonding.

Scalise: This was gold ball bonding. . Yes, and some of it was not even ball bonding. Some of it was just a compression bond.

Laws: Wedge?

Scalise: The wedge bond, yes. But we figured out how to do it and then built some very good equipment. For transistors where the others were doing it manually, we built high speed bonding machines for die attach and wire bonds that allowed us to make plastic transistors much lower in cost than anyone else. That's one of the things that put Motorola on the map and got us going faster than anyone else in the industry. So, it was a great experience. Once I got that going, I was given the integrated circuit operation to get into production. . Then we had another problem; we didn't really have a good packaging capability and we needed to do something to improve that. So, Les [Hogan} asked me if I would go run the packaging operation and see if we could get that in shape. So I said, "Okay, I'll go do that." So, I took the packaging capability that we had and went around and looked at where the technologies were and found that there was better ways to do all this. So we transformed making the packages using glass to metal seals. Some of the [packages] were welded caps. Some were plastic molded. Ultimately we had to do them all. Also the first dual inline packages were beginning to come into play. So we built that [capability] to a point where we were doing a very good job of providing packages for all the products that we were manufacturing; even power transistors. We were making the

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glass to metal seals for those. With that success, he then said to me, “Well, we got a problem with our plating operations. Will you take over the plating operation?” So I said, “Well, okay.” So I went over and that was really a terrible business because at that stage you didn’t have very good systems for scrubbing the air effluent coming out, although we were working on them and we got them much better very quickly. It was a very complex operation with a lot of systems and problems that you had to contend with. But nonetheless, we went to work and decided we really needed to scrap what we had and build a state of the art plating operation. So we put that in place. And then we really had a great plating capability with a good packaging capability for both transistors and integrated circuits. So we had a full supply chain within the factories.

Laws: Do you know how big Motorola was then in terms of the overall semiconductor industry?

Scalise: When I first got there, we were in the five to ten million dollar a year range making zener diodes, some germanium power transistors and just getting into the germanium mesa [technology]. That would be in ’61. Then in ’67, that’s the time I’m now up to, we were something in the vicinity of $150 million dollars a year. We were beginning to vie with TI for the number one position. At that stage, the Fairchild effort was just coming forward but they weren’t where we were yet, but they came on very strong after that. At that point, we wanted to build a factory in Toulouse, France to begin to supply Europe. So Les Hogan asked if I would go to Europe and head up that operation. So, I went and did that. That worked out really quite well. Got that up and running. Got the market working in Europe. We had also built a factory in Korea by this time for assembly and test. Following up on the things we had talked about earlier. So, we really just continued to build on that foundation. Each step along the way I was fortunate enough to be given a lot of key jobs. I was asked] to go take on the next [big] task and make that work. I was fortunate enough to make it a success each time.

So after being in Europe for less than a year, unfortunately, the opportunity came up for Les to come up here to the Bay Area to take over Fairchild. By that time, Noyce and Moore had left Fairchild and Intel and other companies were being started. There was a big hole with the management team and they needed someone. So, I went to the Bay Area. There were seven of us. We were given the nickname of “Hogan’s Heroes” at the time. I got involved with working on the Fairchild turnaround and doing all that was necessary there. There were lots of good things that came out of that. There were a lot of issues but that’s always the case when you’re doing something of that nature. But all in all, it was a good experience and it was a success. A lot of learning that came out of that period. I ran the international operations more than anything else although when I first joined I took over all the administrative activities; finance, the whole thing. Then eventually as we got bigger, we changed to a product structure organization.

Laws: Was the decision to go with Les to Fairchild a tough decision or did it seem obvious at the time?

Scalise: I had a good job at Motorola but there was also a reason to do it. And the reason was that I felt our success at Motorola was going to provide me a good income, a good standard of living; and that was great. As a family we were going to be just fine in that regard. By that stage, we had three children. I’d gotten married while I was in Phoenix. In fact, my wife, it turns out, was also an engineer. She is math and physics trained and ran quality control at Motorola. I met her shortly after I got there and we were married six months later. So it was just one of those things that---another part of that serendipity that just

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works out well in life and here we are today, almost 50 years later. I'm still married, three children, six grandchildren; it's been a good life together.

But as for the experience and the opportunity to go to Motorola, when the opportunity came I thought the difference is there [Fairchild] I'll get stock options for the first time. And with that I had a chance to go beyond just making a living. I can build some equity for my family. And I felt that was the opportunity that I had to take.

Now, let me step back because there's a reason behind this. When I took over that packaging operation at Motorola, I'd never had a stock option. Never even heard of one. But I was promised that I would have a stock option if I took that on. Once I accomplished the goals they set out for me. I went back to ask for my stock options. "Where are they now? Can I get them?" They said they had run out. They didn't have any anymore. But they would allow me to buy some stock and they would loan me the money. That was legal at that time. You were allowed to do all those things. And I remember going home and telling my wife and I said, "You know, this is one of those opportunities where I think I'm damned if I do and I'm damned if I don't. If I don't do it, I don't have the chance to get equity. If I do it, I'm taking a huge risk because if the stock goes down, I don't have any money to pay this thing off." Well, shortly after, as things would have it, they ran into problems in the TV division and the stock did plummet. So, my $100,000 of investment was down to less than $50,000. So I had a paper loss of over $50,000. And no way that I could ever pay it. And when this [Fairchild] opportunity came, I said to myself "I've got this big debt. I've got to find some way to deal with that and yet I've got this opportunity that I want to take advantage of." I decided that I had to take the chance and do it; that we were going make this thing a success. I would make money out of it and I'd get beyond this loan debt problem

Well, it turned out that Sherman Fairchild was still living. He was Chairman of the Board and very active in the company. He recognized that we were taking some risks in coming to help bailout the company. So he made a commitment that if we did certain things, he would compensate us for these losses that we incurred or at least I incurred. And I thought "well, that really seals it then. I'll do it"." Well, we accomplished what we set out to do. He lived up to his commitments and I got that behind me. It took a few years. There was also a lawsuit that was involved in that process, which we also won. It was one of those lawsuits that happens from time to time that you get accused of things that never happened. But that's just how life is.

Laws: Was it resolved over something to do with anti-slavery criteria?

Scalise: It was that we weren't allowed to leave and go to a company together because there were seven of us as I said. But there was no conspiracy. There was nothing at all that had been alleged. It took five years to get through this process, as lawsuits will [often]. But we got through it. We were found not guilty of anything and that was the end of that. But I learned a great deal about what you do and what you don't do in taking risks in the course of all that, starting with the Motorola stock options and what happened there at Fairchild and how that worked out so much better. So, lessons learned earlier are lessons well learned I guess.

Laws: Fairchild never quite regained its former prominence or the expectations that Hogan came with. Any insights into that?

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Scalise: Well, first of all, when the teams left to takeover National and start Intel and other [companies] that took place during that period, there was a talent pool as you well know, that was just truly outstanding. And as that was depleted, it was difficult to build anything up like that, quickly again [absent the possibility] of doing something like Intel did; starting from ground zero and building it ,knowing who all the players were. So, that was part of it probably. The other was the fact that the business was changing a lot. A lot of the things that we did at Motorola to automate the manufacturing operations were of some use but other people were catching up. The equipment industry was beginning to develop and there were outside suppliers of bonding machines and other equipment that made [you] more competitive. So, you weren't able to necessarily implement the same strategy that we did at Motorola. And there was a whole new set of issues as far as developing new products and the challenges of doing all of that. So it was that combination of things. Whether all of those differences were recognized as quickly or as thoroughly as they should have been or if we didn't act fast enough it was probably some combination of all of them. Yes, it never really got as big as we had hoped it would but as you said, we stabilized it. We got it growing again. It was profitable. It was doing reasonably well.

Laws: What stimulated your next move to AMD in 1974?

Scalise: Jerry Sanders had started AMD in '67 as I recall. '67, '68; something like that. And they were at that [start-up] stage again, in the range of about five to ten million dollars and he and I had a conversation about coming over there and helping him to build that into something much, much more. So, I took over a lot of the administrative functions. Eventually before very long, I took over the manufacturing, the backend. John Carey was running the front end of the business and I was running the backend of the business. We did really well there. In the early stage, in '74, I remember how close we came to going bankrupt during that very difficult first quarter. I remember sitting down talking with Jerry about "We had to do this, we had to do that." We talked about various strategies that we might implement. Some of them through the distribution channel where there was a better option in the short term while you're getting designed-in in other areas on the OEM side. And we implemented it very, very effectively. Jerry, as you know, is one of the smartest, most capable people I've ever met in my life and one of the most decent and fair people I've ever met in my life, and a guy that I like and admire a great deal. He saw the future so well and was so determined to do what was necessary to meet his objectives and the company's objectives e that there was no getting in his way and as you know in having worked with him that Jerry had the courage-- has the courage of a lion. And there is just no give. That's all there is to it. So, that was a great experience at AMD as we began to [transform] what was a second source company. We built the business as a second source, making devices that were MIL qualified and therefore got a little higher price on them and we had a little different market that we could serve. And all the things that gave us our edge based on what we had available in the way of a strength. But that then built as time went on and we did very, very well over the next 14 years, building a great company with a great reputation. We moved into the microprocessor arena as that began to unfold with the deal that we made with Intel in the early 1980s.

Laws: How is Jerry's style in making decisions with his staff? Was it consultative? Did he have a predetermined decision and just wanted to figure out how to implement it?

Scalise: Well, I think it depended on what it was that you were dealing with. What decision you were trying to make. I think it could cover a spectrum of methodologies and times, but he was always drawing on his staff for decision making cooperation support. He wasn't a guy that was dictating to you what you

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do, when you do it, how you do it. He was very much one of consulting with you on the things that needed to be done and how we had to go about it. What your thoughts are and how you laid out your game plan to go achieve what objectives we had and what challenges were out there ahead of us to get in the way of those objectives. So I found working with Jerry a delight. It was just one of those things where it was always a challenge but it was always fun and we had a great deal of success. So, that made it all work!

Laws: What was your biggest contribution to AMD?

Scalise: I think I helped first of all to organize the way we did business in those very early days. We didn't have a lot of processes and methodologies in place for running the manufacturing business and the inventory management and the purchasing tie-in to manufacturing. So I put all of that together and at that stage, as you well know, we didn't have much in the way of computer capability. But as I recall, that was about the time that the MANMAN System came out and we were very quick to adopt that and implement it effectively. I believe we managed our business methods manufacturing and inventory management and, better than our competition. . And as a result, we were pretty effective. We were a good manufacturing company because we had to be because we didn't have advanced technology at that stage. That came a bit later. And we were able to succeed with that; I would call it superior business process and manufacturing capability. We were good.

Laws: Applying computers to improve the efficiency of the business.

Scalise: Yes, applying computers very early, very early. You've got to remember, that when we opened our plant outside of Manila in the late '70s we didn't have a telephone in that factory for two years. We ran the factory with the plant manager going to a hotel three mornings a week and call me and we would then talk through all of the manufacturing plans and inventory management; everything we had to do. We had spreadsheets in front of us that we both worked off of at that point. Think about it. Two years without a telephone and it was a very successful manufacturing operation.

Laws: Times have changed.

Scalise: Times have changed. <Laughs>

Laws: Is there anything you could look back and change at your time at AMD? Any one thing that stands out?

Scalise: I don't know. I've never been one to look back in that way. So I don't think I could ever come up with anything. I mean, there are a lot of highs. There's a low here and there in life but that's just the way things work. No one escapes those highs and lows to some degree. But without question, in all the years, the 14 years I was with Jerry and AMD, there were a whole bunch more highs than there were lows. And we got through those lows and kept going to the next high. So, it all turned out well.

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Laws: When you joined AMD it was about a $10 million dollar company?

Scalise: About that, yes.

Laws: And 14 years later when you left it was what?

Scalise: At that stage, well, in the ’84, ’85 period, as you recall we had the memory debacle. We were at a run rate in ’84; a run rate of a billion dollars a year. But by September of ’85, we were back down to a half a billion run rate because of the collapse of the memory business during that time. And then we crawled back up over time. I don’t recall the dates and numbers right now. But we got back there again. But the other things that were so good about the relationship and the experience at AMD is, it was at the time when we were trying to figure out as an industry how we were going to continue to grow and develop technology and develop talent and keep our position in the marketplace. The Europeans were coming on. The Japanese during that period, in a lot of people’s minds, were looking invincible. And so we had to begin to do things differently. It was in 1982, that we decided that we would put the Semiconductor Research Corporation together to begin doing collaborative research in conjunction with universities. And that solved two problems. One is the development of technology that we weren’t able to do on our own because it was too [risky] and cost too much time as well. And the second being we would get students out of these programs who would be able to come to work and apply this most advanced technology. Hugely successful program and as you know, is still going on today. There’s still a roughly $40 million a year program at Semiconductor Research Corporation that we set up back in 1982.

Laws: You were also responsible for public policy.

Scalise: Well, yes that evolved because again, it was one of the needs that had to be filled. And we were beginning to see the first indications that Japan was going to be a different kind of competitor. Their market was not open. It was a closed market. They were capable of dumping product in the market against all of the GATT Rules at that stage; WTO Rules today. We had a huge debate within the industry as to what to do about that because at that stage, Japanese TV manufacturing had taken over the TV world. We didn’t have anything left here in the US. So they were a big customer, yet those same companies were also a big competitor. And having the courage to step up and say, “Well, they may be a customer, but they’re also an unfair competitor and therefore we have to address the unfair competitor part of this relationship or we aren’t going survive”. It was a very difficult process to work our way through and come to that hard decision. But we did. And we did that around 1985, after a couple of years of gut wrenching thought and decision-making.

Laws: What was the industry body that coordinated this process?

Scalise: It was the early stages of the Semiconductor Industry Association. The five founders of the SIA were Noyce and Sanders, John Welty down at Motorola. Wilf Corrigan and Charlie Sporck. Bob [Noyce] took over the role of public policy at the SIA. I remember we would have meetings. There’d be two or three of us; he and myself and one or two others and that was about it. We were trying to figure out how to deal with Washington and how to deal with these issues. Bob was an absolutely brilliant guy and one of the nicest people in the world. I used to say, “You’re the only guy I ever met that’s magic. Whatever

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needs to be done, somehow you can figure it out and make it all happen. Therefore I think you have to be magic." We used to kid about that a lot. But he was. I mean, he was just a phenomenal talent in so many ways and one of the greatest guys in the entire world. So, we began to figure out a little bit about how we dealt with Washington. We began to go there periodically and work on issues. And about that stage, Bob was going out and doing other things so I took over public policy in the early '80s. Maybe '82 or '83, I don't recall exactly when it was because SIA was formed in '77. And I began to really feel strongly that if we were going to survive and not become another consumer industry failure taken over by the Japanese, we were going have to address the dumping and market access issues. Finally, we convinced the Board that we had to do this, the Board of the SIA. I was the central player in public policy to shape that. Now again, I had a lot of support and a lot of help and guidance from the Board members but on the day to day, it was primarily my job to go drive this process.

Laws: Even though you were employed at AMD at the time?

Scalise: Even though I was employed at AMD. Right, right. And actually the other thing that was important about that was we didn't have a lot of money because we were pretty small. Intel was beginning to do better at this stage and they put up a good part of the money for the legal support and the other things that we needed to file these cases. So that's when we put together two cases. One, the 301 Case to deal with the denial of market access in Japan and the second was the dumping case that they were dumping and not only in our market but in third markets as well. And that was a big step.

I remember when we took those cases to Washington. At that stage, Mac Baldrige was the Secretary of Commerce. Great gentleman, wonderful guy. Died far too young. And Clayton Yeutter was the US Trade representative. When we first went to Clayton, to give him the dumping case, I said to him "Here's our case. Now we've got one or two choices. Either you find that we're right in our allegations or if we're wrong, tell us and we're going have to figure out what we're going do next." And when we went to see Mac Baldrige and gave him our 301 case data, Mac was very supportive. He knew a lot about Japan and he felt right away that we were probably on the right track. At any rate, in a very short period of time, they came back and said, "You guys, you're not only right, you don't have half the data. It's a lot worse than you think it is." So, with that, we really began to pursue the two trade cases. And we won both of them. It was a lot of horse trading.

A lot of tugging and pulling to get there but one of the things that was so important to that---there were two pieces to it that were important. One of them was that I insisted that we have something in the agreement that would allow us to deal with their commitment to live by the rulings and their failure to do so, that we could apply some remedies. Our idea was never to punish. It was always to make them comply, feeling that, if they complied with the laws as we complied with them, for both market access and for dumping, we could compete effectively. We never felt they were better than we were. We felt that was just a myth. Couldn't say that at the time because it wasn't very popular, but we felt that very strongly. So that's the way we approached it and, once we got the trade agreement in place, we waited a few months and they still weren't complying so we went back to them and said, "Either you comply by March or we're going to go to the government and put tariffs on." They still weren't complying by March so, at that stage, we went to our friends in Washington and asked President Reagan to apply tariffs on products that were not related to the semiconductor technology but related to these companies that were violating, because what we wanted to do is to get them to deal with the issues that we cared about in a competitive way. Then they got the message and they all of a sudden started to comply.

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Now, the second thing that we had in there was a side letter that said, "The way we will determine that we have been successful (we knew that we could have 40% of the [Japanese] market) when we get above 20% [of the Japanese market], we will know that we have succeeded." That side letter has always been a big point of discussion about how that came about, but I can assure you, there is a side letter that says exactly that. And, as a result of that negotiation and that trade agreement between the U.S. and Japan, the U.S-Japan Semiconductor Trade Agreement coming into being, we stemmed the flow of Japanese product to the level that they were competitive and we were able to regain our share of the market in Japan without the impediments that had been there before.

Laws: Do you remember what the share was before?

Scalise: About 5%.

Laws: About 5 and it went up to just over 20%?

Scalise: Right. We felt that that was a huge success and it was. It changed everything at that point. By that time, we were beginning to get a lot better at a lot of things and I can say the rest is history but there's a lot more that goes on beyond that.

Laws: Did you find that Washington was very aware of the semiconductor industry in general?

Scalise: No.

Laws: So you had a lot of education to do.

Scalise: When we first got there, they had no idea what we were talking about or who we were and we didn't matter. We weren't a General Motors or we weren't a big oil company or a big energy-- we were these guys who were making something called a semiconductor and they [U.S. government] had no idea what it was. But it was also true at that time there were a lot of folks in Washington, in congress, and in the administration that were very receptive to legitimate argument and discussion as opposed to someone coming to town looking for a handout. We never went to Washington looking for a handout ever. I think that that made a huge difference but it also was a different time in Washington. There was a much more agreeable atmosphere, not like it is today where it's so polarized. That was not the case then. And, in fact, one of the things that followed this period was when we formed SEMATECH because we felt we needed to improve on our manufacturing. We actually got legislation passed to allow us to form SEMATECH without having to go through all the burdens and processes that you have to with normal government funding of a program. We also got the government to agree that they would put up half the money and we would put up half the money to a total of $200 million a year. That was a huge program at that time. I mean, you think about that. $200 million a year. That was big. That was a major turning point because, when we did that a lot of people in Washington became aware of what this industry was doing, what its potential was and why it was important. Having the dumping and the 301 cases, putting together the SEMATECH program, having the SRC already funding research, we were beginning to build credibility and a portfolio of activities that were becoming very important and becoming

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recognized. As time went on, we became much more effective in Washington and much better recognized.

Laws: Another project at that time was the Chip Protection Act. You were involved in that, I presume?

Scalise: Right. We went for the Chip Protection Act, as I recall, in 1984 to protect the design of a semiconductor so that you couldn't copy it. You could reverse engineer it but you could not copy it because, at that point, people would just take a photo of the layers and generate the mask set that they could use to duplicate what you were making. We just felt that was absolutely unfair but there wasn't anything in either copyright or in patents that would protect against that [practice] so that's how the Chip Protection Act came to be crafted.

Laws: So it was essentially a copyright of a mask design?

Scalise: Yes, that's essentially what it turned out to be but there wasn't any mechanism for doing that until then. The other thing we did was to initiate consortia research; we changed antitrust law as it relates to those activities for the first time since 1900. It was the only, in fact, it may be still be the only, time that the antitrust law was changed in that way. That was another aspect of [our influence].

Laws: That was part of the SEMATECH issue.

Scalise: Yes. .

Laws: Interesting.

Scalise: So we began making a lot of important contributions and to make important changes in Washington. We built up a cadre of folks in the Congress that became an effective support group, real believers and real supporters. In fact, one of the things that we did was we put together something I don't think has ever been done before or since. We decided that, when we had something we needed to do that was important, we needed support from both sides of the aisle and we also needed both the House and the Senate. So we put together a U.S. Semiconductor Congressional Support Group. Ten Democrats, ten Republicans and, of those 20, ten in the House, ten in the Senate. If we needed to move legislation or get Administration support, we would put together an outline of the needs and the justifications and we would go to these 20 folks. We could count on them as long as we had a legitimate argument and were pursuing it in a legitimate manner, which we always did. They were there to support [us]. They were on key committees and they would be the catalyst to get us where we had to go next. It was remarkable the successes we had in dealing with legislation [and Administration policy that] really made a difference.

Laws: Was there much push back from the computer industry at this time? They were benefiting from Japanese dumping in terms of getting low priced products to build their machines.

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Scalise: Well, that was probably the most difficult part of dealing with that issue because, yes, they were benefiting from [the dumping] and for us to sit there and make the argument, "Yes, but, if this continues and we go out of business and there's no competition, those prices you enjoy today are going to go way up here and in their home market where they want to make those same computers, the prices are going to go down and you guys are going to be out of business next." They never quite bought into that.

One of the things that I did -- -I was Chairman of the Public Policy Committee during this period and we always did things by consensus. We didn't take votes. We did it by consensus because we truly were trying to do the right thing for everyone and then go compete as you know we have all these years. One of the things that I got the major companies to do, and I'm now talking about IBM, HP, primarily to a lesser degree Digital, we got them to agree, “Okay, if you don't buy into our arguments, that's fine, but you can't divide us on the Hill. You have to stay neutral. If anyone on the Hill asks you, you guys are neutral on the issue and allow us to go make our case.” They agreed to that and that was a very important [position] because there was a signal in them being neutral that said there was something good about this that needed to be recognized and, as long as we pursued it legitimately and appropriately, which we did, we could gain support and we did. So we were able to deal with [dumping and denial of market access]. Even though they weren't happy because they weren't getting the same prices or they wouldn't have continued to get the same prices once that dumping case was resolved. They came to realize that there was real benefit and it was being done in a proper way. That partnership continues to this day.

Laws: The industry was beginning to evolve into another phase towards the end of your time at AMD with the fabless semiconductor companies just starting off.

Scalise: Right.

Laws: How did that look from AMD's perspective?

Scalise: Well, early on, there was a feeling that, if you were really going to be able to compete in the business, you had to have your own fab [wafer fabrication plant].

Laws: “Real men have fabs”.

Scalise: “Real men have fabs”. There was that statement made which was kind of unfortunate, perhaps, but I think there was something being said there that was important as well and that is, you can't differentiate yourself if you don't have your own wafer fab. Your own process technology development was a differentiator, not only in your product, but also in the process, so that you could make a better product. That’s what was behind that thought process and that conviction of you had to have a fab. It took several years to get through that process and I think it's a bit unfortunate, because it probably could have been a smoother transition. But maybe that's not possible. Perhaps when you're going through something of that nature, the different views that are going to unfold are, by necessity, contentious to a degree. As a consequence, the integrated device manufacturers, the IDMs, continued to do what they were doing. They ignored what was going on in the fabless/foundry model and, although it was getting off to a pretty slow start and with a lot of difficulties, as you got into the early '90s, it began to take hold.

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The big advantage and the thing that was most important here was that the barrier to entry to the semiconductor industry dropped dramatically because now you no longer had to build a building, buy all this equipment, put it all in place, have the manufacturing knowhow, have the process, development, all of these things because there wasn't anyone else to develop the process for you. You had to go do it yourself. You took all of that out of the equation, so the barrier to entry into the industry dropped dramatically and, all of a sudden, you saw bright young folks who said, "Well, we don't have very much money but we've got a good idea for a product and we know how to design it," and with that the fabless/foundry model began to take hold.

Laws: Sure.

Scalise: It's also true that to date, it has not reached much beyond 25 to 30% of the worldwide market. It's still in that range but it's a very good and very important part of the business. We've transformed the SIA, at, to the point where, when we first were involved, they were all IDMs (integrated device manufacturers). We now have, of our 15 board members, a third of them IDMs, a third of them are fabless and a third of them fab-lite. We've made that transformation and, find that there's a lot of synergy and there's also a lot of tension because the business models are different and benefits of one versus the other vary from company to company.

Laws: Sure. So we've now come up to the late '80s and I think it was the late '80s when you resigned to go into a very different industry.

Scalise: Yes. I went to the disk drive industry. I was on the board of Maxtor and the CEO, founder, decided that he really did want to retire and he wanted to do it sooner rather than later. It was a small board; I was the only guy from the industry side. Everyone else was a VC. I was the only one that had manufacturing and operating experience, so they turned to me and asked if I would take it on and I thought, "I don't know if I want to do that or not." After some thought, I decided it would be a change, and probably a good thing to do.

Laws: So this was your first opportunity at a CEO position.

Scalise: Right. It was the first opportunity for a CEO position and in a whole different business. I had to learn a lot. Looking back over the years that we have discussed---the manufacturing and the research work, developing the process technology, and manufacturing for integrated circuits and then packaging and then the plating and so on, I always went to work in the operation that I took over. I would work for a few weeks at every job, so I'd really get a feel and understanding of just what it is that they're going through, what some of the problems are. So, when it came time to talk about it, I really understood it from a hands-on approach of having done it. I thought, "Well, if I take that same approach here, I will get to know the disk drive industry just as well." The first thing I did is I went to work manufacturing disk drives, sitting on the production line.

The thing I came to realize was that the disk drive, in a mechanical sense, was even more complicated than a semiconductor. By this time we had developed a lot of [manufacturing] capability in semiconductors that made it a lot easier than it had been. We were also into the scaling [era] and the

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evolutionary aspects of it. I also realized that, when you're trying to fly a read write head off of a disk at a few mils and, if the disk crashes, the disk drive crashes. The aerodynamics and other aspects of it were a real challenge. It was a great learning experience. In the three years that I was there, we took that company from about $150 million a year to a billion dollar run rate. It was a good opportunity. I learned a lot and I still, to this day, feel that all the things that we did, moved from 5.25" disk drive down to the 3" and eventually the 2.5" was really a major step in moving that whole industry and the capability forward. That was a good experience as well, yes.

Laws: I think you merged or acquired, was it MiniScribe during this time?

Scalise: MiniScribe, yeah. That was quite a story. If you may recall, David, MiniScribe was a company that was doing quite well when I was at Maxtor and I couldn't figure out how they could have such good [cost and earnings] numbers when we felt we really had better product than they did. We had good relationships in the marketplace and we were growing but, somehow, they could make more money than we were and I could never figure it out. No one could help me understand this better. Well, finally, it came to light. What they were doing is, when they were making shipments, before they actually shipped [the products], they were taking out the disk drives in the middle of the pallet and they were putting bricks in their place. So they were shipping fewer disk drives than they were accounting for, because the pallet weighed the same and the way they counted was by the weight of the pallet. At the end of the quarter [they would ship the pallets], right away, as soon as the quarter was over, they would recall the shipments the pallets they were able to do this for quite some period of time. It finally came to light when someone, somewhere, I don't recall the details now, found that, they weren't all disk drives, there were some bricks in these shipments. So they went bankrupt. They did have some good [products and] manufacturing that they were able to invest in during that period because they were doing very well financially. We took advantage of their crisis by buying them out of bankruptcy and that capability moved Maxtor into the mainstream of the small disk drive industry.]

Laws: They did this to show consistent revenue growth quarter to quarter?

Scalise: Yes.

Laws: That's how they managed to fix it.

Scalise: It was a remarkable game plan that they laid out and executed for quite some time. But, once that collapsed, I decided that it would be a good thing for us to buy [MiniScribe] and take advantage of their ability to invest into the next generation products much more than we were because they were making a lot more money than we were.

Laws: And the next generation at that time would have been going from 5.25 to...

Scalise: 3" and then the 2.5, as I recall, yes. Later they got a lot smaller than that. They had some good automation technology that we bought... We put Maxtor into the 2.5 drive business and that was really the objective I had because, we had some guys who felt that the opto drive was the better way to go. It

didn't appear to me that we were going to get very far with that technology but there was huge support for it because it was going to differentiate us from everyone else. Well, as you know, that never really did become good data storage [product]. It's great for less critical applications, music and so on but certainly not for data storage. So, yes, that was a good experience as well. It was a very different set of issues and challenges and opportunities but the three I spent, I learned a lot and we had a lot of success, so that was good, too.

Laws: From then, you moved on to National, right?

Scalise: I went to National Semiconductor, yes.

Laws: And what year was that roughly?

Scalise: I think it was in '91, yeah. Charlie Sporck had just retired and they had hired Gil Amelio from Rockwell. Gil had been at Fairchild when I was there. Again, a very smart guy, a brilliant guy, good engineer out of Bell Labs. Did a lot of the basic work and has the patents on many of the CCD devices. He has about several patents in that area. He asked me if I would be interested in coming over and working with him as he took on the challenge of molding, building and shaping the company. So I said, "Okay, that sounds like a good thing to do" because I was, at that stage, looking for what I wanted to do next anyway. That turned out to be, again, a good experience. There was one thing that somehow we never were able to come together and do as a management team and that was to spin-off the non-analog products because the real opportunity for the company was to be an analog and eventually an analog-mixed signal company, that's where our great strength was. All of this other stuff that we had was in discretes and old logic families, and we weren't really that competitive in that arena. But we never were able to get everyone together to agree to do that. There was always a tug of war. You could always rationalize it any way you chose to. But, nonetheless, it was a good experience, it was a good program. Over the years, the company did well while we were there. There wasn't a lot of transformation that did take place in the management of the company and the product portfolio but the major step that would have made a bigger difference was if we had gone analog and mixed signal at that time, I think it would have added even more to the strength to the company.

Laws: But, by that time, National got rid of all the systems businesses and the Data Checkers...

Scalise: Oh, yes, that was all gone [long] before that.

Laws: ...and the consumer, that was all gone.

Scalise: Yes, everyone had gone through that period. Everyone was going to be a computer company, everyone was going to be a consumer company, and everyone was going to make a watch. I mean, those things all took place in the '70s and '80s.

Laws: That's right. So your role working for Gil was, again, as his chief administrative officer?

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Scalise: Yes, chief administrative officer. Running the day-to-day business for him while he was focusing on other aspects of [the company].

Laws: The same kinds of things you did at AMD?

Scalise: Right. Now, one of the other interesting things that happened during that period was, we had an operation in Israel, Migdal Haemek, up in the northern part near Lebanon and we decided to sell it off. I was given the responsibility to go sell [it], close it down. In trying to sell it off, we had several potential buyers, but everyone got up to the finish line and then would back away. So, finally, we decided to put it into a joint venture.

We formed a joint venture and it was interesting because the company that we ended up doing the joint venture with was a software company out of New York. It was run by a rabbi, a guy by the name of George Morgenstern, who became a dear friend of mine, marvelous guy. He was every bit a rabbi but he was every bit of a software engineer and he handled the combination very, very effectively and was really very good. So we put this joint venture together and I went on the board of it and spent three years taking this joint venture from [an IDM to a foundry]. This fabless foundry [model] was beginning to look like it had some potential. We put this into a foundry because there were some pretty good capabilities there. It has done okay. It hasn't really ever blossomed into a huge foundry. I'm not quite sure why that is because I haven't been involved with it now for 15 or more years.

Laws: Is that Tower?

Scalise: It's now Tower Semiconductor, yes; It's still there and it's still functioning and it's still doing okay. In fact, they bought a small foundry from down in southern California not too long ago and merged that in.

Laws: Wasn't that Gil Amelio's company? Jazz?

Scalise: It was. It was the old Jazz Semiconductor, right. They bought that out and merged it in. That was a good experience. Learned a lot about, not only Israel, but the business processes. So it was a good [experience], yes. It worked out okay.

Laws: What was going on in the industry at the time you were at National?

Scalise: It was the beginning of the fabless foundry model really taking hold. There were challenges in the various segments of the market, those that were easiest to get processed through a foundry, in some cases, the easiest to design and, therefore, begin a new business. So that was really most of what was happening. I think it was [during that period that] the idea that everyone was going to be in every [segment of the] business changed. Up to that point, everyone was going to be in memory, everyone was going to have a microprocessor, everyone was going to have a microcontroller family, etc. But then the realization began to emerge that that just wasn't going to work. [Conventional wisdom became that a company] had to have a much narrower product line [with significant market penetration rather] than a

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broad total [capability]. That was probably the biggest transformation that took place during that period of time.

Laws: National was still in the processor business at that time?

Scalise: Yes, they were. But, again, like everyone else who was in that business, they only got about halfway in before their opportunity was being [overwhelmed] by [those with more advanced products].

Laws: National did some pretty creative things in the processor area, the first 32-bit processor, I think, a whole bunch of other things but were never really able to exploit it against the juggernaut that they were faced with out there.

Scalise: No. You could say the same thing about Motorola. Motorola did some very good things.

Laws: Yes.

Scalise: But when IBM selected the X86 family instead of, what was the Motorola family, the 68000?

Laws: The 68000. Then they had the Power PC.

Scalise: Yes, then the Power PC followed that, which ended up in the Mac. But, since it's never gone into the PC, that business never really [reached its expected success] at Motorola, either.

Laws: We're going to move on in a minute to your adventure at Apple but I think you had something you wanted to comment on about Fairchild and the entry into Japan.

Scalise: Yeah. A couple of things with regard to the Fairchild days that I didn't think about earlier. When I first got there [Fairchild],, you weren't allowed to put a factory in Japan at that point. The market was beginning to grow and we thought that was a place where we ought to have a factory but they didn't allow it. They actually had laws that forbid a foreign company to build a semiconductor factory in Japan. So we kept thinking about that and trying to figure out how we could do something about it. Then one day in the news there was an announcement that Prime Minister Sato and President Nixon were going to sign an accord that would move Okinawa from a protectorate of the U.S., or whatever that legal arrangement was, back to Japan. Any company that was in Okinawa would then become a part of Japan. So I went to my boss, Les Hogan, and I said, "You know what? We have a way to get into Japan. If we can put a factory into Okinawa, when the reversion takes place, we'll be in Japan and there's nothing they can do about it." So he said, "Do you think you can do it?" I said, "Yes, let me go try." About that time, because that first announcement that I referred to took place, in May and, by now, it's September. [The second announcement stated that the accord would be signed in ten days.]

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Having had that conversation with Les when he gave me the go ahead, within a day or so of that, the announcement came out that this meeting and this signing of the accord was going to take place in about ten days. So now I had only about ten days to do it. So I went to him and I said, "I'm going to go over right away and I'm going to figure out how we'll get this done." We had a law firm in Tokyo that we had been working with just as a matter of course because we had an office there and just [as] normal doing business, we had a law firm we worked with. There was a young fellow there who spoke really good English, very bright guy, and I stopped in Tokyo and I picked him up and I said, "Let's go down to Okinawa and we're going to have to start this factory."

By this time, we had lost two days, so [we] were probably down to, like, six or seven days left. "We've got to start this thing in the next five days so that we can be in Okinawa when the reversion is signed." So I said, "I'll tell you what, you do all of the legal work, I will do everything necessary to get the factory going and, whatever decision we have to make, you just tell me, I'll make it and we'll go." Well, we went into a flurry of activity for the next five days and had a couple of major problems that we had to get through from the legal standpoint but, with the help of some of the folks there and some good legal work on his part and some pushing by me,, we got those things resolved. We then started moving equipment from Hong Kong. We had a manufacturing operation in Hong Kong so I flew some testers in and some product in so that we could begin to test products and that would legitimize us as a manufacturing operation. Well, at the end of five days, we had a building. We had a sign on it that said, "Fairchild Semiconductor." We had equipment inside [the building]. We had diodes we were testing and we had seven people working. We opened our books at the end of the fifth day and we had one day to spare by then and we were in business.

It was probably three months after the reversion documents were signed that I received a letter from MITI, the famous MITI of Japan, Ministry of International Trade and Industry, and they said something to the effect that, "We understand that you have a factory in Okinawa and that's not permitted." So we then began going through the process, "Oh, yes, it is." The law said that on reversion if we were in Okinawa legitimately, then they were in Japan legitimately. Well, this went back and forth for quite some time. They were just beside themselves because no one else thought of this. They didn't want to set a precedent but they couldn't do anything because of the reversion taking place, but they really didn't want an important U.S. semiconductor company to be legitimate in Japan.

Now, prior to this, TI had made a deal with Sony to get into Japan in a very different way, in a partnership and a joint venture arrangement while we were doing it on our own. After battling back and forth for some time, we finally said, "We will do a joint venture as well," and we did. We put together a joint venture with TDK and it turns out that worked pretty well. We got that thing up and running. It was doing quite well by the time I left Fairchild. I know later on they separated. I never was too clear on what happened or why that was, but the experience in and of itself was really a very interesting one and one that was quite special in a lot of ways. It turns out that, if you really think of something that's a bit different and you go pursue it hard enough and with enough aggressiveness, perhaps, you can make some things happen that otherwise just wouldn't occur.

Laws: And especially with the experience that you had, both on the legal side and on the manufacturing side. Otherwise to pull something together like that, it'd be very, very difficult.

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Scalise: Yes. In five days in particular. To get it all done in five days was really quite a feat. So we were always very proud of that.

Laws: Let alone getting permission to test your testers out of the factory in Hong Kong, I'm sure they didn't give those up easily.

Scalise: No, no, but, all in all, we made that work out.

Laws: Congratulations.

Scalise: There's another thing that comes to mind with regard to SEMATECH that I think is also very important. I've seen it written about a number of times now and I think, in every instance, it's not been reported accurately. When we first started SEMATECH, I was chairman of the board of the Semiconductor Research Corporation. Bob Noyce was the first chairman. There was another guy who followed him and who was in place for just for a couple of months. He left and I took over as Chairman, so I'd be the third or second, it doesn't matter. I was very much involved in getting the SRC program up and running.

During the time that I was Chairman, and over the next several years, one of the things that we recognized was the Japanese issue of manufacturing. We concluded, at SRC, that what we needed was a manufacturing research capability. So I was to give a talk at a forum in Boston and I said to the guys at SRC, "I want to give a talk where we propose the formation of an organization that is going to do manufacturing research to make certain that we are competitive in that area just as we are in the process technology and the design area." So I gave the talk and, in the course of it, I decided that we would give the Semiconductor Industry Association $50,000 to study this idea and come up with a proposal that would implement it. I took that to the SIA, the next board meeting, and made the presentation and the offer of the $50,000 from the SRC. It was really seen as a very unique idea, that this could be something really good.

At that point, the board decided they would go ahead and take a look at [the idea] and Charlie Sporck was given the lead role to make this happen. A few of us were put on a committee to work on the location of the site. [It then] began to unfold and, over the next year, we went through the process of site selection, looking all over the country looking for a site where we might want to put the Center, and how it should be structured, etc.. First of all, the state of California was not interested, unfortunately. It would have been the best place for it because that's where more of the capability existed at that time. This was in 1986.

Everyone from the Governor right on down, made it very clear that they really wanted this SEMATECH operation in Texas. At that stage, Motorola and AMD had put manufacturing capability [plants] in Austin and they were just getting them up and running, Austin [also had] an IBM facility, but not much else. It was really not a technology center at all. As time goes on, and as one thinks about how things have evolved in Texas, this became one of the real catalysts to move the city of Austin and Texas, aside from what TI had done in Dallas, into the mainstream of advanced technology semiconductors and related activities. Dell computer and [others] were in the future still. So it was a very important step forward, but

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what was so interesting about that was that, as we put that program together, it became obvious that managing a program of this kind where we had a total of 15 companies in the original agreement, putting up the $100 million a year, so that was a lot of money because we weren't that big, none of us, and yet we had to come up with $100 million [in matching fund to the government's $100 million] and we didn't have any problem doing that. When we brought the presentation to the Board, everyone put their hand up and said, "We're in." No problem with that at all. So we got the money. We got the idea. We bought, as I recall, it wasn't Digital Equipment but it was the other small computer company from Boston...

Laws: Data General?

Scalise: Data General. They had a facility there in Austin that was now empty. We took that over. Then managing this operation became the next challenge, how are we going to do that? So we hired a guy to [head it up]. After several months, that just didn't pan out.

Laws: Was that Paul Castrucci?

Scalise: Yes. We came to the realization that we had to do something different. So Bob Noyce came to me and I remember we went to lunch at the Los Altos Country Club [where we were both members]. We talked and he said, "You ought to go and take over that SEMATECH operation and get it going." Going back to my earlier comments, I said, "No, Bob, you're the one that has to go do this because now that we've run into this problem, we need someone who is the obvious choice to be the leader and you're the only one who can do that. I would love to think I can. I think I can follow you. I don't think it would be the right thing for me to do it." Well, we had this debate back and forth for probably three hours. It was four or 5:00 in the afternoon by the time we finished our lunch and he finally agreed. He said, "Okay, I will go do it but you have to commit that you will take over following me." Now, at this time, I had just taken over the Maxtor opportunity and I said, "Okay after I do what is needed to be done there, I'll be able to do that."

So we went on and he and I stayed in touch all the time, talking about what was going on. I was not on the board at that stage because I had stepped away from the AMD at that point so I was no longer on the board of SEMATECH. I went back on again when I went to National. We stayed in touch as things unfolded. In the spring of 1990, if I remember correctly, May, he called me and said he wanted to meet again. So we met. He said, "Okay, I'm ready to retire from SEMATECH. We got a deal. You said you would take over after me." I said, "Okay, I will. Just give me until the end of the year," because I had just bought MiniScribe at that stage and I had to really get that integrated into the company. I said, "I need to get through this process. I think it'll take me between now and September, no later than December, but I will make a commitment, end of the year, I will leave and I'll come and take over SEMATECH." So we agreed because the timing would work for him also.] That was in early May. It was in early June, I received a call on a Sunday morning that Bob had passed away that day.

Laws: Passed away. That's right.

Scalise: Yes. Passed away that day. Then I was in a real dilemma because I was in the middle of this MiniScribe thing and, although I had made the commitment, I didn't see how I could do anything about it right now and a lot of people didn't even know about that conversation he and I had. Some probably did

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but it was really something where that was just the way it was going to work and that's the way it would have worked. We decided that the best thing to do at that point was to get someone else to take over because I really couldn't do it at that point. That's when Bill Spencer came in and took it over and did a great job from that point on for the next several years. But, again, I think that those two discussions have never been, to my knowledge, ever reported accurately as to having first of all taken place and then exactly what was involved in the two discussions.

Laws: That's interesting. I had no idea. I was aware of Bob's running of the company for three years and then his death.

Scalise: Yes, that's how that actually transpired.

Laws: Okay. Thank you for that. So let's pick up now at where you followed Gil Amelio from National over to Apple. This would be about, I think you said '96?

Scalise: In '96, early '96. Gil was on the board of Apple. He had been invited to go on the board of Apple, I don't know when it was, '94 or '95, I don't recall exactly. As you may recall, they got into a fair amount of difficulty during that period and they were looking for someone to come in and turn it around. They approached Gil and, actually, we were in Hawaii for a meeting when he told me about this, that they were approaching him and he was thinking about it. That was about the extent of it. There was just that kind of a discussion. So, within a very short time, a week, a week and a half, he decided that he was going to go do this and he announced that he was going to Apple.

Once he got over there and he saw what he had, he called and asked if I'd be interested in coming over with him and do the same thing I'd done before, be the Chief Administrative Officer and pull things together. So I looked at it and I thought well, you know, this could be a really exciting, interesting experience. I think it might be a good thing to do. This was about a month after he went over there. I came over in February. What I found was, first of all, we hadn't hired a new Chief Financial Officer yet, so we had to get someone for that slot right away. We had some names that were in the hopper there to be talked with but nothing had been done yet. So we got to that process and we got a Chief Financial Officer in place.

Then we began to really look hard at where we were. Well, it turned out that we had about enough cash left to survive about three, at the very most four, months and we would have been bankrupt. So, obviously, being in that set of circumstances, we really had to move fast. We had to do something that was going to keep the place alive. I honestly think, David, this is probably the hardest I have ever worked in my career. The reason being that the quality of our product was so bad at that point, the bezels were cracking, the power mounts in the back of the machines were breaking off. I could go down the list of problems that we had. We had to take back virtually every laptop we had shipped in the prior two years. That was just compounding the felony. As I looked at it and [thought], "We have [quality] problems, we've got excess inventory, and yet we don't have enough because our suppliers that have critical components, they won't ship them to us." It was a case of “you name the problem and we had it” and we had it in an order of magnitude more complicated and more difficult than you could possibly solve. So I would work late at night and into the early morning hours, talking to suppliers around the world, making deals so I could get materials I needed , during the day, we were working on the issues that we had to solve to get

the products both back and corrected and new products began to go back out the door. It was a whole litany of issues.

Then, beyond that, we had excess people. We had a huge talent pool. Great people but far, far more than we could ever tolerate, given the business volume that we had. We also had-- some deals that had been made prior [to our arrival] that were in place dealing with our high end computers that had been licensed to someone else to make and sell and that was taking the best part of our business and destroying it. I could go on down the list. So we worked through all of these issues as fast as we could. We were shutting down operations, we were having to lay off people, we were redeploying assets, ---.

The net of all that is, as we got to the middle part of June, as I recall, we began to get to the turnaround point and were able to display and demonstrate that we were now on our way to getting this thing not only stabilized, but on an upward swing once again. Now, we still had to get some new product lines out, but we had all that under way. As a result of, by the end of June, instead of being bankrupt--- now, remember, I went there the first part of February---instead of being bankrupt in June, we had $1.6 billion in the bank, $650 [million] of that came from an overnight transaction that we did once we had stabilized the company. That was a huge task and important process and effort that, to this day, I don't know that that story's ever been adequately told with regard to how Apple survived that dire period in the history of the company.

Once we got to that point, we were also trying to develop the new operating system, as I recall it, it was Mac OS8, if I remember correctly, and lots and lots of problems getting that developed. It had been [in development] before we got there and it was still being dealt with at that time. We began to look around to see what options were available to us to improve on the operating system. One of the thoughts was the NEXT operating system that Steve Jobs and the guys had developed at NEXT, could be the one that would do [the job]. My personal view was, “that may be true”, based on all of the things that I was being shown and told and I understood. “That could be true”. But I also felt that it was a lot of money, $400 million of our hard-earned treasure of $1.6 billion, and that I really didn't want to part with. So I argued for licensing the OS. . They were willing to license it to us or we could buy it. I argued for licensing. My view was, “hey, if it works, we'll go ahead and pay the license fee, it'll be worth it. If it doesn't work, doesn't cost us anything and we're in good shape”. I was the only one who stood on that side of that argument. Everyone else on the staff really felt it was important to buy the company -- so that's what we ended up doing. This was in December 1996. We bought the company, and, at the same time, we were in the process of working through the idea of reorganizing and restructuring the company so that it was ready to take on the new products that we were dealing with, get this operating system in place, all the things that were happening.

In parallel, we were also negotiating with Microsoft on the issues that we had between Apple and Microsoft. So I was spending a lot of my time going back and forth to [Redmond], Washington to deal with that set of issues. In January of, that would be '97, or late December, right at that time the decision was made to buy NEXT and to have Steve Jobs and Steve Wozniak become aligned with Apple once again. So they got involved. As I recall, they attended the Mac World in January of that year.

We then restructured the company to a functional organization, which is the way they are still functioning today, and got rid of all of the business units. -- Everything had its own business unit. We put it into place

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a new structure. We brought in a team of very good people, including Jon Rubinstein and Avie Tavanian who stayed on for many years. They lead the teams that engineered the resurgence of Apple. By May, when we had the company restructured, I felt that I had done everything that I had come to Apple to do and enjoyed it but I was wondering what I might do next when I received a call that the president of SIA had resigned and they asked if I would be interested in being president of the SIA.

Laws: Okay.

Scalise: It was at that point then I made the transition and came over to the SIA..

Laws: So that would be middle-'97 you made that move [to the SIA].

Scalise: [June of 97], yeah.

Laws: So that was a year-and-a-half of hard labor [at Apple].

Scalise: Very hard labor; very hard labor, but very satisfying...

Laws: But it certainly laid the foundations for the recovery...

Scalise: And again, I don't think the story has been told well enough, and I don't think Gil Amelio has ever been given the credit he deserves for what was done in turning Apple around.

Laws: Wasn't the iMac the machine that came out that Jobs got most of the glory for? , I understand a lot of that work was done under Gil's tenure.

Scalise: Yes, that's right.

Laws: So, let's talk about what you've been doing for the last 13 or 14 years, George. The SIA. For the benefit of those 200 hundred years from now who are looking at this, tell us a little bit about what the SIA is. We've referred to it a number of times as a trade association for the semiconductor industry, what was its real charter?

Scalise: Well, originally the Semiconductor Industry Association charter was to develop a statistics program so we had an idea of what the market was for semiconductors, and what share of the market that we had, how fast it was going; all the things that you would think about as to what is this industry that we're in. In the late '70s, SIA was formed in 1977.and that was the number one reason for its formation.

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Another was to think about how we would address the issue of avoiding the takeover of the industry by, Japan as they had the consumer industry. We made the commitment among ourselves that we were not going to be taken over by anyone; that we were going to survive as an independent and a strong industry in the semiconductor world. So those were the two major issues that were the catalyst for the [companies] coming together and forming the SIA. We've already talked about some of these things that we did over those years to stabilize that competitive environment that allowed us to do as [well] as we were capable of doing. It turns out that was pretty good because by the mid 1980s when the industry began to settle out a little bit, we had over 50 percent of the worldwide market and we felt that we could continue to [hold] that [position]. When dumping was taking place, we lost our market [lead]: we went down to the low 30s, Japan went well up over 50. Our view was that that was only because of the distortions in the marketplace; it wasn't because they were more competitive than we were. But given the environment where everyone thought that Japan was so [much more] capable compared to anyone else, you couldn't really say anything, it was always [seen as] sour grapes. So we never talked about it that way, we just figured out as long as we have a competitive environment we know we can win. Turns out that having solved that problem through the 301 case and the dumping case and then the ultimate trade agreement that came out of that, by 1993 we had regained our 50 percent market share[--- it wasn't quite 50 percent at that stage, a little bit lower than that, but we eventually got back up---] once again. We overtook Japan. Today we're a still little over 50 percent of the market again, have been for some time.

Now, as I mentioned earlier, we started the Semiconductor Research Corporation in the early '80s to do pre-competitive research: it's not basic research, not commercialization; it's training those young folks to come into the industry with good technology [backgrounds]. So when I took over the SIA I began to look around, to see what do we need to do next? Craig Barrett at Intel was the chairman of the Technology Strategy Committee and he and I spent a lot of time thinking about what we could do to make certain that we continued to lead this parade down through the CMOS scaling era. And what we concluded was that we needed another program to fund research that would make certain that we lead the technology development through to the conclusion of ultimate CMOS.

Now, let me step back: in the early '90s when I was at National, Gordon Moore was very much involved with the SIA. We had a meeting one day at the SIA where he laid out the idea of putting together a technology roadmap that would allow us to move the industry forward and give everyone some indication of what was coming and when, what the issues were to allow us to plan and prepare. That roadmap started in '92 and we continued to refine it as we went along, and it has become a very, very important part of guiding the industry and its investment and research since that time. But one of the things that we were seeing in '97/'98, when I first got involved, was that there were a lot of issues on the roadmap that we didn't have any way of addressing. So Craig and I decided that we ought to put together a focus center-- it became known as the Focus Center Research Program. It was obvious that we didn't have anything like Bell Labs any longer. That was done away with in the early '80s and all of the great research that came out of Bell Labs that helped guide and steer industry was no longer available. We decided we needed to create something that will be Bell Labs II. We decided we didn't want to label it that, but something that would allow us to achieve that same capability. And after much thinking, we came up with the idea of a research program in universities that would allow us to deal with these issues, using the best talent at universities across the country, the best young graduate students, have that be the basis for this research [program], we could achieve the objective of continuing to move down through the CMOS scaling era and dealing with those tough technical issues that lay ahead of us. We first set out four [centers of excellence], again determined by the roadmap, as to what needed to be addressed.

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Laws: The roadmap was Gordon Moore's idea of where you needed to go over the next 10 years or whatever to achieve certain objectives?

Scalise: Yes. It's actually a 15-year look ahead. Yes, that was the idea. With the roadmap, we knew what the key issues were: one was design and test; another was layout and interconnect; systems and software were becoming an issue, they weren't very big at that stage because you didn't have that much embedded, and all of the other things that have been become now so much a part of the industry and its differentiators; and then we had the fundamental materials, device and structures. So that's when we set up Berkeley, Georgia Tech, Carnegie Mellon and MIT. That began to work really well and so in conjunction with those four we brought in a number of other universities, about 35 others at that point.

Laws: SIA companies put so much money into a fund which is then allocated to each of these programs?

Scalise: Right. We put up the first money and then eventually we went back to DOD, much as we did with SEMATECH, and that's a point I want to make here, and said "Hey, we're willing to put up some money for this research program, it's going to benefit everyone, it's basic research, you guys ought to be willing to put some up too." [It took] a lot of tugging and pulling but we have had, and continue to have, DOD, DARPA, as our partner; 50/50 partner just like we had with SEMATECH. This is not nearly as large a program because the kind of research we're doing isn't quite that expensive, but it's a $40 million-a-year program. We put in 20, they put in 20. So that's the way we have been driving this program. We did add the Focus Center in UCLA about three or four years ago to begin to deal with the nanomaterial needs that will be integrated into the process as we go forward. That has been a huge success; we haven't missed a beat anywhere along the way.

Going back, a point that I should make and I think is extremely important, is when we put SEMATECH together in '87 we had serious problems that we needed to address, but we knew what they were and did a good job of addressing them and overcoming the issues that were out there ahead of us. By '93 we knew we had solved the problems we had set out to deal with. The question is what do we do now? And we concluded---and I was on the board of SEMATECH at that time, along with Craig Barrett and a bunch of other guys---was that we would go back to DOD and tell them “we do not need Government money anymore; we have met our initial objectives we'll take care of [the other issues] on our own from now on”. The folks in Washington could not believe it. They [had never had anyone] come back and say “We don't want $100 million-a-year” and so they tried to make us keep it. They said ", this is a hugely successful program, go find some other things to do, we want you to continue to do this." We said "No, this is the problem we came to solve, we've solved that problem. If we come up with another problem then we'll come back." And it was really with that background and thinking that when we put together the Focus Center Program I thought that we ought to go back to DOD and get them to cooperate once again. Wasn't quite as easy because there were a whole different set of people, as you would expect, but nonetheless we have been able to build that relationship, build that partnership, and with that the Focus Centers have been hugely successful. We continue [implementing Moore’s Law], doubling about every 18 to 24 months just like we thought we could.

Going forward from where we are now, let's call it the 45 nanometer node [minimum dimension] the problems get bigger. They're getting to be a bit more costly and yet I'm confident we're going to continue to deal with them, overcome them and implement the [needed] technology and continue to move down

through the next several nodes. In 2004 I thought, the nano era is out there ahead of us and we aren't doing anything about it; we have to begin to think about how we make the transformation from the CMOS scaling era to the nanotechnology era, and what is the overlap? How do we get them to mesh together? So I sat down with Craig again, we talked about putting something together called the Nano Research Initiative (NRI). It has three phases. The first phase is to take a look [over] the horizon [for] activities and opportunities and see what are the best ideas for the switch that will succeed the transistor, what will the structure be, what materials [will be used], how will you manufacture it, etc.?;

So we put the program together, in broad terms, in three sections. The first one will be to look at that portfolio of opportunities [best ideas] of what that switch might look like and begin a sorting process that will get us down to the five to ten [ideas] that look like they're the most likely candidates. The second phase then will be to prove out, prototype it, demonstrate that it does work and it does what we want it to do. And then the third phase will be to actually design the structure, build the manufacturing capability with the materials [needed]. We're now at the stage with our NRI effort where we have about eight options that look like they have the potential of being that next switch. We have been able to, through simulation, to demonstrate that these look pretty good. We can probably reduce the power consumption by three orders of magnitude which will do exactly what we want to do in terms of reducing the power consumption in the computer communication centers, make battery life [much] longer than it is today, etc. Now, maybe if they ever solve the battery problem, well, there'll be two solutions working together. [At that point], we're going to have battery life that's going to be [very] good. But in the absence of that, if we do our part we're going to be able to do an awful lot to extend the life of the battery as it is. So that's where we are now. Last week I was in Washington, I'll be back there probably next week again, talking to the Department of Energy. Considering all of the enthusiasm within the Government today about energy saving and new ways of doing things, the thought we have is that this seems to us to be an obvious place for Department of Energy to put some resources to help take us through this next phase of the research. I expect the NRI effort will be a major contributor to the energy reduction challenges of the future. Now, beyond that, as you well know, applying the same capability to light-emitting diodes and larger lighting fixtures, we'll have [even greater savings], which is probably the biggest opportunity for energy savings of all.

Laws: Fascinating program, George. Realistically when could you expect the first commercial switches using this kind of technology to be available?

Scalise: I think from a production standpoint you're probably still 12 years away. To get to a first working prototype I think that that's something we can achieve in the next three to five years.

Laws: It's an exciting program. So that's one very important focus area you've been working. Are there government initiatives still being pursued by the SIA?

Scalise: A lot of government initiatives. Well, let me step back for a minute: when I first got involved we were trying to sort out how we should be dealing with Asia, and in particular at that stage still Japan. And we did set up an office in Japan, so that we could interact better with the Government and the industry, and do a much better job of dealing with whatever issues came forward [and take better advantage of the] opportunities out there. And through that we have built a great partnership, a great relationship, with the Japanese industry and government. Now, the other thing that happened, as we went through the

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early '90s, the Trade Agreement reached a conclusion. There was really no reason for the Trade Agreement any longer because we had accomplished, as I said, by 1993, all the things that we had set out to do. So we saw no reason for continuing, but Japan thought that this was such a great arrangement that we ought to find a way to keep it going. So we came up with the idea of the World Semiconductor Council that would allow membership of all of the semiconductor companies from around the world to get together and deal with issues of common interest that related to government policy. So that was the structure we set up, and is still in place today.

There is one meeting a year by the industry leaders in May, where we bring forward the issues that needed to be addressed. For example, in '98 we agreed to establish a program to reduce global warming gases by 10 percent from the base year of '96. I'm not sure of the year, to be honest, but it was '95/'96; around that time. Over the next 10 years we would reduce the consumption as the industry grows. Now, we're on our 10th year and we're not only going to meet that objective, we're going to exceed it. Again, this was without the EPA or governments or all of the political circus that surrounds so many of these activities today. We did it because it was the right thing to do and we have been very successful in implementing it.

We have continued during that same period to look at the semiconductor workplace. There has been an allegation from activists [asking] “Is it a safe workplace?” We've had three studies prior to this one that said there is no scientific evidence [suggesting] anything but a safe workplace. [The semiconductor work environment is a safe one]. We're now in our final study of 100,000 employees going back over thirty years [on the topic]. It's another $10 million we've invested. We'll come out with the final report in June/July of this year and, again, all the data gathered over the last many years indicates once again the semiconductor manufacturing area is a very safe [place]. The way we handle our gases [and chemicals we use] in manufacturing makes for one of the safest manufacturing industries in the country. And, in fact, by the Department of Labor statistics, we're the number two safest manufacturing industry in the US. We're very proud of that and we're going to continue to make sure we maintain that leadership in manufacturing and safety.

In addition, we have been much more active in promoting the industry and its accomplishments in a broader sense. I have taken the opportunity of reporting the sales numbers each month to highlight what the industry is doing. And through that [effort], we have been able to raise the level of awareness of the industry to a much higher degree than it ever was before. Now, not to the common man because, again, there's no way that they can really relate to the semiconductor. It's still so "Well, what is it and why is it?" and "I know it's in my computer or it's in my cell phone but..." so we don't try to do it at that level, we try and do it with economic and operational and other statistics. So maybe one month I'll talk about the fact that our recent analysis will tell you that the PC of today is about 100 times more powerful than it was 10 years ago and it's only costing you a third of what it did 10 years ago. They can relate to that statistic. . But the one that is most important that I've been using and, again, very effectively is we [have been] the largest export industry in the US [for the past five years].

Going back to your comment at the outset: what was it like when you first started going to Washington and I said no one even knew who we were. Now they know who we are because we are the largest export industry in the country. The point is that we are [a very large and important] export industry in this country today. We still manufacture here in the US 75 percent of what we sell.

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So the issue in Washington then is how are we going to maintain this; what are we going to do to make certain that five or ten years from now we still manufacture 75 to 80 percent of what we make here in the US and we're still number one in technology and number one in market share at 50 percent. Those are the objectives I've had all along and we've been able to maintain. That's my greatest concern because we do not have an investment policy within the framework of government activity today that will encourage both US-based companies and foreign-based companies to come and invest in the US; it doesn't exist. We [have] the second highest corporate tax rate in the world. We do not do anything to encourage investment here in the US. There are lingering concerns about industrial policy and corporate welfare which have nothing to do with how you compete in today's world. What needs to be done, and one of the things that we're really focused on, where I spend a lot of my time, is educating those in Washington that are involved in this process. The way we've broken it down, there are really two issues. Number one, if we're going to compete in the world of tomorrow the globalized economy, which is very, very different than where you and I started out, Dave, when the US dominated everything. Remember after World War II we were the only country left standing and we had a 15 to 20 year head start when there was no-one that could compete with us. So my point is that what we now need to do is make certain that going forward we do two things. Number one, we strengthen those areas where we're already very strong: basic research, the rule of law, innovation, IP protection, and most important our research university system, it's the best in the world, nurture it. The second is look at the world around us, see what it will take to compete and win in that environment and make certain we do the things necessary to achieve that objective. We must choose to compete as a nation in our tax and regulatory policies.

Laws: What do you say about investment in the US; about Government policy, or lack thereof, in the industry?

Scalise: Now, the question that you can ask then is why is this important if they make it in Taiwan or somewhere else? Well clearly we need to create jobs here at home. We need to create manufacturing jobs. Manufacturing matters. There are too many folks today that somehow believe that manufacturing doesn't matter. If there isn't any manufacturing, we get to the point where somehow the world economy functions without manufacturing, then I guess it doesn't matter. Well, I don't think that's going to happen. Now the fact that manufacturing is a smaller percentage of the total economy than it once was, as agriculture's a much smaller percentage of the total economy than it once was, that's fine. But you still have to have a presence, and a competitive presence, in that arena. And we can, and especially in semiconductors because when you look at the cost-structure it's driven by the capital investment. It's not driven by labor costs or anything else, consumables, nothing. It's capital intensive and therefore...

Laws: Right back to the arguments we had about Japan in the '70s.

Scalise: That's right.

Laws: Cost of capital in Japan versus US.

Scalise: Right, zero, [in Japan] and we were paying a real price. We can compete and have manufacturing here in the US.

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But the second reason is going back to my comment about one of the major, great strengths of this country is our research university system. It is the crown jewel of this nation and it is one that we have to maintain, take advantage of and utilize. Now, I've had the good fortune to lecture at some of the best universities in the world including Tsinghua, Peking, Fudan. They're getting better, but they're not close to any one great research university in the US; not one of them yet. So the issue really is, if we have that strength and we nurture it and we turn-out that technology and we turn-out those students, even if they are foreign-born-- and we have to do a much better job in our K12 so that more of our children go into those graduate programs in math and science, but even if we do have to continue for some time with foreign-born students, which is fine, then we have to make sure we keep them here, so we need immigration policy, immigration reform that is really enlightened. But then, having done those two things, what are you going to do if you don't manufacture here? Why are these students going to take these tough courses, learn all of this, if the jobs are not going to be here? So there's a reason why you would want to follow that normal progression of activity and have manufacturing here, and especially if you're cost-competitive to begin with. The only thing that makes China more cost-competitive than the US is they have zero taxes, they have huge grants, and subsidies, and with that combination you can save about $1 billion over roughly a seven-year period by putting a factory there [rather] than putting it here. It's not because of the fundamental cost structure; it's because of the constructed cost structure that they're providing.

Laws: Interesting challenges ahead, George. Now, in between all this work for the SIA you've also sat on multiple boards. Some of them are quite interesting: the chairman of the board of the Federal Reserve Bank of San Francisco. How does a techie get into that job?

Scalise: That's interesting because it's one of those things that just happens-- it's, perhaps, serendipity. When I was with Gil at National, he got involved with the Bay Area Council which is largely centered around companies in the San Francisco area as opposed to down here on the Peninsula, although that's changed a bit now. I was his deputy in dealing with the BAC and I got to meet a lot of people [from] San Francisco [with whom] I'd never come in contact before. One of them turned out to be the President of the Federal Reserve Bank of San Francisco, [Robert Perry]. I worked with him on some programs and we got to know each other and worked well together. There are nine directors of the Federal Reserve Bank. Three of them are selected from the banking community. So they're elected by the banks from the banking community. Three of them are elected by those same banks, within the district, that are from the community at large. And then three of them are appointed by the Board of Governors in Washington. Those last three could be either the chairman or the vice chairman of the bank.

[A few years later I got a call from Bob Perry [Federal Reserve Bank of San Francisco President and CEO (1986-2004)] one day, asked if I would have lunch with him to talk about the [Federal Reserve] Bank. I said "Sure', having no idea what he wanted to talk about. So we had lunch and we talked, and he talked about the bank and he talked about the Board and things of that nature, really not giving any indication that there was something here that he was moving toward. I think he was trying to get to know me a bit better outside of the things we had been doing at the Bay Area Council. So we really had a good conversation and shortly after that, then I got another call saying they would like to talk with me and I went up and met with them and the question came up "Would you be interested in being on board of the Bank?" And I thought "Wow, that sounds like a pretty good idea but I don't know a lot about monetary policy, but I can learn". He said, "We need to branch out. We don't have anyone from the technology industry at all; never had one on the Board of the Federal Reserve Bank here and [tech is] the biggest

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industry around here. So I thought, “Well, that's good, I can represent them”. So I agreed to be a candidate and was elected to the Board by the banks.

In my first year I decided if I was going to be on the board I wanted to be very effective. So there's a professor at Stanford by the name of John Taylor. John developed what's known as the Taylor Rule that guides the decision-making with regard to [changes in] the federal funds rate based on inflation and other economic activities. It's a very [well-known] rule and one that has demonstrated viability in good times and bad. So I called John, I said "I'd really like to spend some time with you and be mentored by you so that I can [better] understand and be an expert in, expert to the extent I can be, in monetary policy." Well, that was good. But then there were some other folks at Stanford that were also very good in related areas: Anne Krueger and some other people. So we got together and we had some meetings where they tutored me. I [have] kept up [these] relationships and I call them periodically. The way the Fed requires a vote on the discount rate every two weeks. So you have a face-to-face meeting every month and then you have a telephonic meeting in the intervening two weeks. And you get a complete economic update at each one of these meetings.

Laws: There's a lot of homework.

Scalise: Yes, a lot; a lot. But I decided I really wanted to [do the job well]. I thought, well, they don't know anything about the technology world. I'm going to make a brief presentation, 'because each one of you have to make a presentation at the board meeting, as we're going through the economic analysis so that each sector is represented: real estate, retail, semiconductors in our case, and so on. And I decided I'm going to do this in a bit more of a substantive way. So I developed about four slides that I would hand out at each board meeting. One of them would be on the market and what our position is, and what the sales are for the industry, and where we are, and so on. One had to do with inventory and so on. And with that I gained a lot of recognition.

One day, about three or four months into the time I was on the board, the chairman of the Federal Reserve, Alan Greenspan, came to attend our meeting. And I made that presentation and he said to me after "That is good. This is what I'm taking home with me." So I thought “Oh, that's pretty good. If I got his attention then I guess we're doing something right here.” So that was in mid-summer and that's about the time they start looking at who are the next board members, because there's always someone rotating off each year. But also they came to me and said "Rather than have you.....stay on as a class two member…we're going to move you to a class three and you're going to be appointed by the Board of Governors and with that, then you can become the Vice Chairman and eventually the Chairman of the Bank." So that's how I moved from the one position to the other and I became Vice Chairman.

When you're Vice Chairman, you go to Washington and meet twice-a-year with the Board of Governors and all the other Bank Chairs and Vice Chairs and deal with issues of the whole system. You also have some responsibilities in between, dealing with various elements of what the system entails. So that worked out pretty well and I continued to gain more understanding of the [Federal Reserve] System, but I needed to work at it.

Then I was promoted to Chairman of the Bank when the Chairman For the last year there's another step you can take and that is someone chairs the Conference of Chairmen. I was elected to [be the Chairman

of the Conference of Chairmen of the Federal Reserve System] in my last year. I was responsible for the Conference of Chairmen activities. So it was really a great experience and to this day I feel that this is one of the things that helped me really broaden my horizons. I've met with the governors of banks of China, Japan, and I still have many of those relationships and can still have access to them. I continue to be involved with meetings at the Bank here, in fact, I'll be there tomorrow. But getting involved in monetary policy, really working at it to understand it better and using some of the great resources we have here at Stanford was a great asset to me.

Laws: Do you get termed-out of a position like that?

Scalise: Yes.

Laws: You serve three years or some...

Scalise: Two three year terms and that's it.

Laws: And you finished that when?

Scalise: In 2005 I finished.

Laws: That's fascinating, George. I didn't understand that aspect of your career until I looked through your resume the other day. You were also on President Bush's Council of Advisors on Science and Technology (PCAST). What was your function there? Floyd Kvamme was on there for a while as well.

Scalise: Floyd was the co-chair with Jack Marburger, Jack being the Government guy and Floyd being the industry guy. That was a great experience also. That was for eight years. We just went off at the end of the Bush term last year. The PCAST charter is first of all to do studies that are on key issues that the President needs to have a better understanding of and a game-plan for managing. Not just understand it, but what do you do about it? And the second is, and this is why I enjoyed it so much, we had outstanding lectures at our meetings. And especially if you were heading up a study, and I'll get to that in a minute. But some of the best and brightest [lectured] on any issue in technology. It could've been in the life sciences, it could be in the physical sciences, or batteries. It was an opportunity to learn from the best!

We decided to do to do a study on manufacturing and information technology and innovation. I was given the responsibility to chair that [study]. So we put a team together and it's like all of these things, when you chair it you do a good part of the work because you're the one that's going to have your name on it and you want to have it done right.

I did a lot of research, trying to figure out why did we do so well coming out of the Second World War. What was the foundation for our success in the second half of the 20th Century? And what I concluded is that when Vannevar Bush was in the Roosevelt government in the mid '40s during the war, he had a vision for the future based on technology development. His vision called for the government to be

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responsible for funding basic research at our universities and to have a capability within the government to drive technology research. If we succeeded it would be one essential key to our security as a nation, to our better health, to more jobs, to a higher standard of living and to our cultural progress. I found his vision compelling and the results over the next several decades confirmed that he was correct.

I [then] went to the National Science Foundation. And said “take a look at this and develop a vision that to guide or efforts going forward? This is now 50-60 years old, let's come up with a new vision." They did a great job; I then selected a paragraph out of each one of these as the foundation for this study, The one that Vannevar Bush put out and then the one that [the NSF] put out. And the paragraph I selected out of this letter, paraphrasing now, basically what it says is “What we need to do is continue to strengthen those areas where we're strong and then excel in the developing technologies like bio and nano and so on, to the point where we are so good that we have no competition”. When we did the study, we developed a list of things' that underpin our success such as; the rule of law, our great research universities, a large body of skilled scientists and engineers, reliable utilities and infrastructure, and a level playing field in the international trade arena. And then what is it that our competition is doing around the world that we need to address? It’ is a 32-page, but I think it captures the idea of the vision you need going forward and then what are your guiding principles you need to implement to make it happen? When I was in Washington last week I gave a copy to Congresswoman Anna Eshoo, and I said "You know I keep talking about this idea of an investment policy. This is the framework that will give you the guidance to move toward with investment policy. If you can find a way to get the Congress to do it, this is what we need to do." I'm hoping we're going to do something before too long.

Laws: Was that just published within the group?

Scalise: No, it's on the website. the PCAST website., .I think it's a very good study in that it really gets to the specifics of where you need to go. That was a very good experience. I was involved with a couple of other studies as well. I presented the study to President Bush [in a] two-hour session where I [reviewed the study] with him. And again, one of the things that I'm so proud of with President Bush is he's a very bright guy. . He asks great questions. When he came into a meeting, he was well prepared; he was very interested; he had a good sense of what you were dealing with; as I said, he asked very good questions; he was very probing. I liked working with him a great deal.

Laws: He doesn't give that impression publicly very well, does he?

Scalise: Unfortunately he does much better in a smaller group than he does in larger forums...

Laws: It's your experience.

Scalise: Yep, he is a superior intellect in so many ways.

Laws: Well with all this going on George, what do you do in your spare time?

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Scalise: Go watch my grandchildren play basketball and baseball and volleyball and all the other things that they do.

Laws: That's great. I've got a few, general questions now and then a couple of questions about the museum we'd like to get some response on. So if you'll look over this long career, what was the most exciting, rewarding and satisfying period for you?

Scalise: Well, you know, I think, David, we're all the same in that regard where most of what we look back on are those good things that we can remember and we probably somehow suppressed the ones that weren't quite so pleasant, and I guess we're all probably very much that way. But I feel, first and foremost, that those of us that grew up in this past 50 years grew up in a golden age. And in part it was because we came out of the war as the only country left standing, and we had a running start, and we had a pretty good foundation to build on. So that is number one. Then if you take it to the next level: those of us that were lucky enough to have a career in the semiconductor industry which is the enabling technology for the information technology era we had a huge opportunity to exercise. Experience, learning, and economically we did pretty darn well. It was a very special time and I feel very fortunate to have been a part of it. And again, going back to one of my very early comments, had I not walked into that little apartment of mine at five o'clock on that Friday afternoon and picked up the phone with Harry Knowles on the other end, I don't know that it would've worked out anything like this at all. So it's not all the things that you think about and you do and you decide, some of them happen just because they happen and you're fortunate enough to be there at the right time. I think that's a very big part of it.

Laws: So looking to your grandchildren, what would you do to encourage your grandchildren to pursue a career in science and technology now?

Scalise: Well, what I did with my boys was I encouraged them to take an engineering degree as their undergraduate. And both boys did, they both got a double E-degree, Ted from USC and Craig from UCLA. And I said go do whatever you want to do after that, but now you have a foundation that you can build on. Ted went to work for a while: here and overseas, came back, went to Columbia, got his MBA because he always wanted to be in investments and managing money, and has succeeded there. He's with TIAA-CREF and is a portfolio manager with them. .Craig never went to work when he finished his undergraduate. Went on and got an MBA at University of Chicago and his PhD in economics and is consulting and doing just fine. So they went on different paths, but they have the same foundation. I'm encouraging my grandchildren, as they come along now, to do something similar to that. Now maybe if you want to go into the medical side of things, and I don't think engineering's necessarily the best place to start because it'll extend your time of academia, but get something substantive at that undergraduate level.

Laws: A hard science of some kind.

Scalise: Yes, a science of some kind because that's going to be the cornerstone of whatever does happen tomorrow and if you want to be a part of it, why you've got to start there. Yet my daughter who went to University of Texas and got her degree, Kathy, she did a great job as well. She did not want to be in the work world. She wanted to have a family. And she has a family: four children. They're delightful children, she is the greatest mother anyone could ever want to have and, you know, she's done

exceptionally well in what she does. Each one of them, I think, has found their own way and it's worked out just fine. I would encourage the grandchildren to do the same.

Laws: That's great. And now a few questions about history: why is history important? Why should we collect it? How does it relate the future, the semiconductor computing industries?

Scalise: Well, I think it's one thing if-- we've heard it said a billion times and we'll say it many, many more, I guess, and that is if you don't learn from history, well, you're destined to repeat it. That's both the good and the bad, and maybe more the bad than the good. And I think that's number one. But I think beyond that, history is such a good guide. I mean, going back to my thoughts about how I wanted to approach this study and going back to Vannevar Bush and seeing what his vision was and how that translated to a very successful era, I mean, the National Science Foundation was born out of the vision that he put in a very brief letter. Sent it to Harry Truman, President Truman, because in the intervening time between his conversations with Roosevelt, Roosevelt had died and Truman had taken over. But I think that's another example, that vision was a critical part of what got us to where we are today.

Also I think appreciating what it is that's happening here. What we haven't even talked about, because there's so many things we can talk about, the semiconductor industry generates-- drives more productivity growth in this economy, and not only here but around the world, than all other industries combined. It is the most important contributor to the improvement of the standard of living for everyone in the world... More than healthcare and healthcare is critically important, but this is the primary driver. It is the only industry that really reduce inflation in a significant way and we reduced inflation more than anyone else. There isn't anyone even come close to the inflation reduction that we bring with our lower prices and greater functionally and higher productivity. So when you have something as important as this, understanding it and dealing with it and communicating it and nurturing it is so important. We aren't going to solve the rest of the issues ahead of us dealing with cancer and other life science issues if we don't spend more time and energy in the physical sciences. Whatever diagnostic and other work needs to be done, it's going to be done because you've solved the physical science problems and applied them to the life sciences.

Laws: You've built the tools...

Scalise: The tools, yes; the analytic capability. Looking at history and understanding it-- and virtually all of my reading is history; I love to read history. I do think that in this period we're in today, reading *The Forgotten Man* by Amity Shlaes is probably something they ought to have as required reading for all young people so they get a sense of the [Great] Depression. And how did it work out? And is that what you're hearing today versus what actually occurred or is there some misalignment of what's being said today versus what occurred? I can assure you that a good part of it's a misalignment right now. Learning from that the Depression was probably one of the good things that came out of my life, yet it was pretty hard as we went through it.

Laws: Finally, what kind of role do you think the Computer History Museum can play in telling the story?

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Scalise: I would like to see, we talked about it just very briefly there at lunch today, is I'd like to see the museum broaden its look at the industry and see what are the important contributions we're making in improving the standard of living? How are we doing that? And what would happen if that shouldn't happen? And again, the thing that I want to try to do as we talk briefly, I want to get the Federal Reserve Bank to take a look at this from their perspective. Why is an industry like this important? And what is it going to do if we do maintain our leadership? And what are the consequences if we don't maintain our leadership; what do we lose out as a society, as a people, as a standard of living? There's a role for the Computer History Museum to look into that, to be a part of dialogue, building of-- that reservoir of understanding and communication.

Laws: Understanding the social aspects of the impact of computing on society basically.

Scalise: Absolutely, yes, very, very important. I would hope that we could branch-out begin to look at that much more carefully. Add that to the portfolio of what you can learn when you come to the Computer History Museum. Why we are where we are, to some degree contributed to by this technology.

Laws: Any last thoughts before we sign off, George?

Scalise: I don't think so. How long's this been?

Laws: Since about one o'clock, my goodness.

Scalise: That's three hours. That's a long time <laughs>; that's a long time. Wow. Thanks.

Laws: Okay.

Scalise: I've enjoyed it, though. I'm looking forward to see what it is that we get out of this and how it comes out.

END OF ORAL HISTORY INTERVIEW

BEGINNING OF EXHIBIT INTERVIEW

The following conversation with regard to changes in technology over George's career was recorded in support of an exhibit in development at the Museum.

Scalise: If you go back 50 years when we were first getting started and we didn't even have a wafer process, we were making semiconductors one by one and then along came the germanium mesa technology which was the first introduction in wafer form and [putting] multiple devices on a wafer. That was a major, major step in manufacturing because that turned the initial phase of the industry into a

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whole new business model. As we moved beyond germanium to silicon, we took the general ideas of what we were doing in germanium mesa and began to implement them on silicon. It was then with the planar process that we reached the point where [we able to have] have the integrated circuits with all of the interconnect and the ease of manufacturing, [It enabled scaling in manufacturing which drove Moore's Law implementation. No longer is it evolutionary as we go down to the late nodes to ultimate CMOS, it has become increasingly more difficult to go from node to node and as a consequence the challenges in manufacturing going forward are greater and greater.

Laws: So process that looks simple enough back in those days was still pretty tough to accomplish back then?

Scalise: It was pretty tough for a lot of reasons, first of all we really didn't know how to do it very well but more important we didn't have any of the equipment necessary to do it, so we had to first of all [determine] what [it was that] we needed to do, then we had to design the equipment that would allow us to do it and then build that equipment and make it all work. Those were challenges that today are a given, but at that point they were major [challenges] that we had to deal with [overcome], outside of manufacturing the device itself. Manufacturing equipment to build a device was a huge task.

Laws: Today automated factories can cost billions and can cover several city blocks, throughout the 1960s you were still building your own equipment and today there's a whole industry to take care of it.

Scalise: Yes, [it's] a whole industry, it's a 50 billion dollar a year industry today, where at that stage [in the 60's] we were [designing and building our manufacturing equipment in-house] on our own.

Laws: Could you talk about what Moore's Law means?

Scalise: Moore's Law is really an interesting principle, a thought process that Gordon came up with that basically said was "Based on what we're learning about the implementation of the planar process, we're going be able to continue to shrink the geometries and therefore increase the number of transistors on the same area, the same real estate on a piece of silicon. We can probably double the number, about every 18 to 24 months." And it turns out that we've been able to accomplish that. [It has] allowed us to pack more devices in, make them smaller, as a result make them less expensive and most important, [faster and use] lower power. With all of those improvements we're able to reduce the price by about 30% each year.

When you look at a bit of memory today, which may have cost upwards of a dollar in the early 1970s when we first developed a memory product. [It now sells for] a millionth of a cent, so it is a dramatic change that has taken place. Comparing the power consumption for one computation on a computer today to [that of] 30 years ago, we consume about one three millionth of the power to make that transaction versus 30 years ago. Those are phenomenal changes, but that's what [the implementation of] Moore's Law has [enabled]. As a result, we have all these handheld devices, [such as] cell phones, MP3 players, laptops and GPS systems and all the other devices available to us today. Then we have changed the business model as well because the phone system in the developing countries is all wireless; they're not going have a wired system ever. It has been [a convergence of many technologies,

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underpinned by Moore's Law [resulting] in cost, power, and energy consumption being reduced as we go, step by step.

Laws: Today's ICs have millions of components, so handcrafting is too slow and error prone compared with the old fashioned ways of doing it. Chips are designed on graphical work stations using computer-aided engineering tools, a single design involving hundreds of engineers, programmers and technicians can take several years. How would you that to the task of designing an IC back in your early days at Motorola?

Scalise: That is another important evolutionary process that has unfolded. In the very early days, we were able to keep the design rules in our head, we didn't have [computer-aided design] capability. In fact the computer was still [at a] pretty fundamental stage. We didn't have that many applications and certainly none for design. Keeping design rules in your head as you continued to make things smaller and more complex [became] more and more difficult, to the point where we realized that it wasn't possible to do that any longer. We had to figure out how to use the computer to help do this job. Keep in mind we have gone from one device on that piece of silicon to over a billion transistors on that same piece of silicon today. That's almost an unbelievable step that's taken place over he years [and that will continue into the future]. We're still increasing the number of transistors on that same piece of silicon. [In accordance with Moore's Law], we'll be able to double it [about every 18 months] and we'll end up somewhere in the seven to ten billion transistors on a piece of silicon. As long as we can control the heat generation, which is a major challenge, going down through the last several nodes and we think we can do that. As a consequence, [we will] continue to shrink to smaller [geometries], make them less costly, [have] lower power per transaction.

Laws: So a chip that might have cost half an engineer's annual salary to design back in the mid 1960s could be several hundred million today.

Scalise: It's not quite that high it depends on the complexity [of the design]. What we do see now is the cost of designing a new product is increasing at a dramatic rate. Where you could do most designs ten years ago for perhaps $100,000, we're now approaching the ten million dollars per [design], but rapidly as we go down from [the point where] most designs are at the 65 nanometer node down to 45 and 32, [the cost is going] up exponentially. We'll be at a hundred million dollars per design very soon. [If it's going to cost that much to design, it has to have a very large market. I Is ASIC technology still a good idea or do you have to go to a field a programmable [device where you can use the same design for multiple devices. .We continue to drive the feature size smaller and smaller and we continue to increase the capability and evolve business models that were not even thought [previously]. They now take on a whole new role as we make each of these transitions. It's a remarkable series of events that unfolds as we move down through the CMOS scaling era.

END OF EXHIBIT INTERVIEW

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