Oral History of Satoru Ito

Interviewed by:
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Douglas Fairbairn: Okay, we are here at the New Otani Hotel in Tokyo, Japan. It is June 20, 2016 and I'm Doug Fairbairn and I'm speaking to Mr. Satoru Ito. Welcome. I'm delighted with us.

Ito: Thank you very much.

Fairbairn: Thank you.

Ito: I'm very much honored to be here.

Fairbairn: So, we are interested in exploring your career and your background and as usual we like to start at the very beginning to see sort of how you found yourself into an engineering and technical career. So, maybe you could start and just describe something about where you born, your early upbringing, and what your parents did and what kind of influence your family might have had on the direction you took.

Ito: Yes, I was born in Tokyo, in 1944.

Fairbairn: Right here.

Ito: Right here, and I've always been in Tokyo. My father was a school teacher in Tokyo.

Fairbairn: What grade?

Ito: He was a high school teacher teaching Japanese literature. I am the youngest of all five sons.

Ito: And, yeah, not many interesting things in my family background.

Fairbairn: Did your siblings pursue a technical career or?

Ito: Well, the reason why I pursued this career in technology is that basically, for one thing, I liked to play with things, devises, to play with. When I was born, Japan was still right after the war, and we had to make all the toys ourselves <laughs>. So, I always played with all these things in DIY (you do it yourself), and I think that was the first kick. I remember I read a book by George Gamow.

Fairbairn: George.

Ito: George Gamow, a very famous physicist who moved from Russia to U.S. and he wrote many books particularly for young kids...

Fairbairn: Oh.

Ito: ...about physics and there was one book called, I think it was, "Tompkins in the Wonderland." I read that book when I was still a very young kid. I was enchanted by that book. It was my first chance when I became very much interested in physics.

Fairbairn: And, do you know how old were you at the time?

Ito: I think I was still maybe seven or eight years old.

Fairbairn: Already reading books?

Ito: Well, yeah, I liked to read books.

Fairbairn: I guess your father was a school teacher so he probably encouraged such activities.

Ito: Well, I don't know. He was a very diligent, serious teacher. He was serious about taking care of other kids outside of family, not very much his own sons.

<laughter>

Ito: Yeah, I did what I liked to do. I studied in Tokyo, all through these years, through an elementary school, a junior high, and a high school, and entered the University of Tokyo. And, I chose an engineering career at that time.

Fairbairn: Was the University of Tokyo engineering focused or was it a broad set of disciplines?

Ito: Well, the University of Tokyo is regarded to be, I think, one of the best or the best in Japan that covers everything, Law, Economics, and Engineering, of course, and Science, and I thought I could have chosen either Medical Science or Engineering Physics. I finally decided to choose the physics because of my strong interest in that.

Fairbairn: So, what year did you enter the University?

Ito: The year I entered the University was 1963. I finished Master's course, Master's degree in 1970 and joined Hitachi. I spent five years in the undergraduate because I spent one year in Ohio State, taking one year off the university in Japan.

Fairbairn: So, tell me about why you decided to go to Ohio State? Why America, and why Ohio State?

Ito: That was interesting. I wanted to see how U.S. was, because I thought that Japan would be like U.S. in 5-10 years. I wanted to see how it was like and I had an opportunity. There was a scholarship called Sankei Scholarship. Sankei Newspaper sponsored that scholarship and paid for everything. My family was not very rich so <laughs> that was very important.

Fairbairn: Yeah, school teachers don't make a lot of money in the U.S. nor in Japan huh?

Ito: And, five boys all going to colleges, yeah ...

Fairbairn: So, did you study science topics at Ohio State or did you just take a variety of things.

Ito: Yeah, I studied physics, but that was not really the purpose of going to the U.S.

Fairbairn: Right.

Ito: I just wanted to see the U.S., what it was like.

Fairbairn: What year were you then at Ohio State?

Ito: I was in the Junior year, the third year of college.

Fairbairn: Maybe `65?

Ito: Sixty-five, yes, in the midst of the Vietnamese War.

Fairbairn: Yeah, so things were really starting to heat up.

Ito: Yeah, right. It was really a good experience for me. I enjoyed that one year.

Fairbairn: That must've been quite a different environment than the one you left...

Ito: Yes, very much.

Fairbairn: ...from the University of Tokyo.

Ito: At that time, there were actually very few Japanese people going abroad and there was no airplane service directly from Tokyo to U.S.

Fairbairn: Oh really.

Ito: I stopped by Hawaii. It was that kind of time. It was really exciting. It was good, it was very good for me.

Fairbairn: Did you tour around the United State while you were here?

Ito: Oh yeah, I used a lot of Greyhound.

Fairbairn: Greyhound bus.

<laughter>

Ito: Very economical trips.

<laughter>

Fairbairn: Did you make it all the way to California at that time?

Ito: Well, yeah on the way back to Japan.

Fairbairn: Oh, you flew through there, yes.

Ito: No, that was also very interesting. I stayed on the campus. I lived on campus and maybe today also, there was a campus paper. ~~M~~any students traveled during the summer holidays, and they tried to gather the buddies to go together. And, one of the students who was in the doctoral course wanted to go to Los Angeles and he picked me up all the way from Columbus to Los Angeles. Also very...

Fairbairn: Got to drive across the country?

Ito: Yes, great experience too.

Fairbairn: Yeah.

Ito: I enjoyed it, yeah. I really found that it was a big, big mistake of Japan that we fought against the U.S.

<laughter>

Ito: Big country.

Fairbairn: Big country.

Ito: Very interesting.

Fairbairn: So, you got to see the U.S. and you went back to Tokyo to finish your studies?

Ito: Yes, I was in the third year when I went and came back at the third year and finished the undergraduate. Then I went to the Master's course.

Fairbairn: So, did the time in the U.S. influence the future direction you took or did it just sort of...

Ito: Not particularly as my career, but I found that the U.S. educational system was such an excellent thing. That was the one very, very impressive thing. That was a good experience too, yeah.

Fairbairn: So, what did you find the major difference between Japan and U.S. educational system?

Ito: Well, I know only about college.

Fairbairn: Sure.

Ito: But, the one thing which was very impressive was the way you formed the total curriculum. There was a big book, very bulky book, just like a telephone book that listed all the curriculum, and you could start from the goal. If you want to take this class then there is a prerequisite for that and for that prerequisite there is another prerequisite. You can go down all the way and that's a very excellent system, and you can choose and make up your own curriculum and that's one thing. And, the other thing is there're so many good, excellent textbooks. In the Japanese educational system, we usually don't use textbooks, just professors either talk or write on the blackboard. <laughs>

Fairbairn: Oh, I see. And, your notes were...

Ito: So, in the U.S. system professors really don't have to lecture, they just ask questions instead. The students are expected to have studied anyway before you go to the classroom. So, that is another excellent point, I think, and all these things are very different.

Fairbairn: Now, has that changed over the last 50 years?

Ito: In Japan you mean?

Fairbairn: Yeah.

Ito: I'm afraid not very much. In Japan, the educational system is that you are expected to study a lot before you enter the college, but many students after entering successfully to the college don't study anymore.

Fairbairn: They don't study anymore.

<laughter>

Ito: They just graduate, I think, after attending classes for four years.

Fairbairn: That's interesting.

Ito: The interesting thing was that when you talked with the first-year students, there were many, many students who were not qualified actually, but they dropped out after second year or third year. We could

see very clearly how the students were selected and grew. So, in the Master's courses, most of the students in U.S. seemed at that time, at least, to be a lot more excellent students than Japanese counterparts.

Fairbairn: Interesting.

Ito: So, that was very impressive.

Fairbairn: Okay, so you came back to Japan and you finished your studies here.

Ito: Yeah.

Fairbairn: And, then you went directly to work at Hitachi?

Ito: Yeah, I joined Hitachi.

Fairbairn: And, how did you select Hitachi or did they select you and how did that happen?

Ito: Yes, I thought I would either go to Hitachi or NEC somehow. And, I was interested in the semiconductor. I studied Applied Physics. I was very much interested in the solid-state physics so Hitachi was one of the candidates for me and the other one was NEC. And, my professor who took care of me in my graduate studies had a very good friend at Hitachi, so he advised me to go to Hitachi.

<laughter>

Fairbairn: It often happens that way.

<laughter>

Ito: Yeah, right. I think that was okay. I mean...

Fairbairn: So, what was the state of semiconductors at Hitachi. I mean semiconductors were so relatively new then.

Ito: Yes, I joined Hitachi in 1970. At that time, the semiconductor industry in Japan was very premature still. The timing was just that we started a very serious business in transistors. We still were doing some germanium business, and the silicon transistor was still in an early stage. And the timing was before we started the engagement in ICs and LSIs still. I think you know Dr. Makimoto?

Fairbairn: Mm-hmm.

Ito: He also graduated from the same Applied Physics Department of Tokyo University, and he was a kind of pioneer in starting Hitachi semiconductor operations. And, I think that was about 1975 or mid `70s when we started very serious work on ICs, particularly for calculators at that time.

Fairbairn: Well, by then you were already doing very well in dynamic RAMs were you not?

Ito: No, not really, still. At that time, we were working on 4K development and in very early development stages of 16K DRAM. No, no, in 1970, we still were before that.

Fairbairn: Yeah, Intel didn't introduce the first 1K DRAM until `71, `70-`71.

Ito: That's right, yeah.

Fairbairn: And so, the 4K must've come a couple of years...

Ito: Right, right.

Fairbairn: Seventy-three, `74.

Ito: Yeah. My first job at Hitachi was-- my original career started as a process engineer rather than design, even though I worked in DRAM area for many years later. In the first 10 years, I worked in the process area.

Fairbairn: So, during the 1970s, you were...

Ito: During 1970s.

Fairbairn: ...doing process development?

Ito: Yes, yes. But, in the first year, the job assignment for me was to improve the reliability of transistor, plastic mold transistor, which was very good seller because of very excellent, low-noise performance for audio applications, but the reliability of that device, particularly as a plastic molded device, was very, very bad. I mean, I don't know if you know, you are familiar with the term “pressure cooker test”?

Fairbairn: Mm-hmm.

Ito: You know that?

Fairbairn: Yeah.

Ito: These devices didn't pass the four hour testing.

<laughter>

Ito: My assignment was to improve the reliability.

Fairbairn: So, what did you find the major issues to be? What areas needed change? What needed to be fixed? What did you do to improve the reliability--

Ito: Oh yeah.

Fairbairn: --to address the reliability problem?

Ito: No guidelines. What I did was just to do tests. As I said, about 50 percent failed after four hour pressure cooker testing and no other way of doing after that. So, what I did was to remove plastics, just to watch the chip surface of all chips and I did that every day for a few months, and finally found out that the failed parts had very irregular looks and that was the start. And, I did all the analysis and found out a very simple thing from today’s point. But at that time nobody knew that phosphor was very unstable against moisture. So, I found the phosphor content of that passivation film was too high. Very simple, but so we found it out.

Fairbairn: Did other companies have the same problem?

Ito: In that particular case, we used what you called LTP, low temperature passivation and one of the purposes of that is to avoid Fairchild planar patent.

Fairbairn: Ah yes.

Ito: After fabrication of the transistor we removed all the thermal oxide and deposited new passivation film after that. And, phosphor, as you know, was the very key ingredient to stabilize the surface, but nobody knew the content of phosphor was so critical. And, until I came to the conclusion that was the cause of the problem. it took me really a long time, but I found it. I made a complete - not really complete, a very drastic improvement. I worked almost for one year to change all the basic ingredients of new passivation, and that formed a very basic career for me actually. And, starting from that point I worked for about 10 years starting from transistor and then _____ ICs, LSIs, and finally I worked on improvement of plastic molded microcontrollers and memories. And, that was about 1977-78 when we came up with the very high reliability plastic molded 16K DRAM.

Fairbairn: Yeah.

Ito: And, also 8-bit microcontrollers, and we went into Delco and IBM, and that was the second challenge I had. I was assigned to get qualification of plastic molded 16K DRAM, which was actually 32K piggyback DRAM for IBM.

Fairbairn: Mm-hmm, they call it Caribou.

Ito: Caribou, yes. I worked on Caribou program and...

Fairbairn: You had one dip package on top of the other right?

Ito: Yeah, at that time, Intel, Mostek, and these companies were the suppliers of the ceramic packages, and we went into IBM and told them that our plastic was as good as ceramic.

<laughter>

Ito: Very low cost, and it took almost full one year to get the qualification. I stayed in Boston to get that qualification. It was a very, very challenging, interesting program I had. I don't know, because of that success, maybe, I was transferred to DRAM operation, after 10 years of process development, and became a manager in DRAM operation.

Fairbairn: That involved the design as well as the fabrication?

Ito: Yes. At that time, we had a Memory Department and within that department there was a DRAM division and other memory divisions like SRAM and E-PROM, and I became in charge of DRAM. It was still at the time of 16K DRAM and early phase of 64K DRAM as I said. And, that was the start of my career in DRAM. So, I worked in DRAM, and later including all memories, in memory areas for about 10 years after that.

Fairbairn: Now that was about the time, I forget exactly when, but when Intel decided to get out of the memory business, right?

Ito: Yeah.

Fairbairn: Was that...

Ito: Well...-when I started my DRAM carrier Intel was still of course a very major supplier, and it was about 1985, I think, when Intel decided to move out of DRAM.

Fairbairn: Was that kind of a big surprise?

Ito: It was a big surprise, but starting from 16K which was the beginning for us as the real serious business in DRAM, and by the success of that generation, after 64K, and particularly 256K, Japan was already a very major DRAM supplier occupying a very major share.

Fairbairn: And, that was largely because of the tremendous yields you were able to attain...

Ito: Yes, I think so.

Fairbairn: ...and the low cost that you could...

Ito: I think yes, that's right, cost and quality.

Fairbairn: Right. Americans didn't believe that you were getting the yields that you were at. <laughs>

Ito: Yes, yield was, of course, the key. And, of course, also the success in very high reliability plastic devices was another key thing. Intel and most other companies in the U.S., at that time, were still working on ceramic packages...

Fairbairn: Right.

Ito: ...which were a lot more expensive in terms of cost. And the quality, reliability we are pursuing for, I think, was very, very good. We made big successes, as you know.

Fairbairn: So, it seems that the Americans just didn't believe that you could attain the yields that you were seeing. Perhaps they didn't even try hard enough because they didn't think it was possible whereas the Japanese seemed to have always said we can always do better.

Ito: Well, yield is, of course, a result.

Fairbairn: Yes.

Ito: There're all kinds of things which were involved, and one very important thing at that time, particularly in Japan, was that we worked very, very closely with material suppliers and equipment suppliers. Most of the semiconductor groups and suppliers today are U.S. players. At that time, in terms of new technologies, the U.S., of course, was very much advanced, but the equipment technologies in Japan, which were related with manufacturing - actual manufacturing - was already very strong. The very close tie cooperation between semiconductor suppliers and equipment suppliers and also material suppliers, I think, created very, very strong competitiveness. Of course, in order to raise high yield, the discipline of operators, and all these things are very important, but together with that, I think, improvement in equipment and material technologies were the key. We worked with all these equipment and material suppliers at that time and these players grew through these activities. But, I think one of the reasons why Japan became not very competitive after a certain period of time was because of transferring all these technologies, particularly equipment and material which were grown together with us, to overseas and became very important key technologies for new players like Samsung and all these guys.

Fairbairn: They all benefited from the work that you had done.

Ito: Oh yeah, I think so. Really that was one of the keys, I think, at that time. The cooperation between semi manufacturers, suppliers, material and equipment suppliers.

Fairbairn: It certainly allowed the Korean industry to ramp up very rapidly.

Ito: Oh yes. I think they owe a lot...

Fairbairn: I'm sure they do.

Ito: ...to these activities that we did.

<laughter>

Fairbairn: So, you then moved to the DRAM. Tell me about the Caribou program and why that was so important.

Ito: Well, that was so important because DRAM business overall was still an infant business for us. And, getting into IBM and adoption by IBM mainframe, which was really the important market that drove our business really, and that was the real major start of our DRAM business and the success of that qualification of plastic molded 16K or 30K DRAM was so important.

Fairbairn: Did you sell the Caribou product to other companies or?

Ito: No, no, that was a proprietary thing and soon after that we shifted to 64K. IBM was, of course, a mainframe supplier long before launching PC yet. Their technology level was of course very high and profound. Other customers particularly in Boston area, like Wang and DEC and these people came up, and they became also the major customers for 64K, 256K. And, we all got a kick in U.S. business and that drove our business.

Fairbairn: So, you managed the whole DRAM activity until when?

Ito: I started to be engaged in DRAM in 1980, and from 1980 through 1985-6, I was a dedicated DRAM manager and after that I became in charge of all memory business. So, in terms of DRAM that was about five or six years. 1 Megabit DRAM development was a very exciting program. Hitachi was a leader in general, not particularly in memory, but also in microcontrollers and system LSIs, particularly in CMOS technology. I think you will interview Dr. Masuhara. He worked in CMOS technology quite a bit, and we applied CMOS technology to DRAM as the first player together with Toshiba actually. Toshiba was a good competent company and together with-- well between Hitachi and Toshiba, I think DRAM was shifted totally to CMOS. And, all the DRAM at that time was NMOS, and shifting from NMOS to CMOS was a big move. It was a very, very challenging project, I remember.

Fairbairn: NEC was also a big supplier then?

Ito: Yeah, NEC always was a big supplier in semiconductor, in general, in Japan, but particularly in DRAM, of course. They were one of the major suppliers, but they were very strong in NMOS technology, but in terms of CMOS Toshiba and Hitachi were leading suppliers for years.

Fairbairn: I see.

Ito: And, after that, I think, Hitachi, Toshiba competed very much. We enjoyed that contest.

<laughter>

Fairbairn: So, then you switched over to the microprocessor area.

Ito: Yeah, after that I was moved to Device Devolvement Center, which was one of the divisions within the semiconductor operation at Hitachi, and I really didn't know anything about ASICs or microcontrollers at that time, but somehow I became in charge of all the management.

<laughter>

Fairbairn: You had people that did know about those things.

Ito: Yeah, Kihara is one of my good friends and he was the guy who worked in the SH microcontrollers, RISC controllers, and what we call H-8 microcontrollers. Together with DRAM operations, Hitachi's very major competence was in microcontrollers, and I worked with all these guys in those areas.

Fairbairn: So, you moved over to the microprocessor area in `86 or `87?

Ito: I think It was in 1991.

Fairbairn: And, had Hitachi already adapted or adopted the RISC ideas in terms of implementation of those versus...

Ito: Yeah.

Fairbairn: ...what can you tell me about that evolution?

Ito: Hitachi started the microcontroller business by introducing Motorola's technology and products at the first stage, and we worked with Motorola for many years in very good relationships. But, after working in that relationship for several years we came up with a very severe dispute between Motorola and Hitachi in terms of IPs and patents, and Hitachi was sort of forced to move out of that Motorola team, and we

decided to develop our own proprietary architecture, which we started as H-8 CISC architecture microcontroller, starting at the first stage as 8-bit and then moved into 16-bit. In the course of that devolvement, the RISC architecture started in the industry more or less as a computer processor application, mainly in workstations, by HP and other people. Our territory was the real-time controller rather than the workstation kind of microprocessors.

Fairbairn: Right.

Ito: So, we had all kinds of big discussions and decided why not applying that technology in micro controller. That was the start of RISC architecture microcontroller which we call as SH. We started first as a 16-bit but internally 32-bit architecture. Performance wise, that was still one of the controllers which other players also supply. But in terms of power efficiency and code efficiency, I think SH was the best at that time, and we made a big success in that.

Fairbairn: You also had to supply design tools and compilers and other things to go with that?

Ito: As the part of microcontroller business of course we did all these things. Yes, we of course worked on compilers and all these things, but our major competence was actually SH chip architecture and hardware, basically. We worked with some game players and worked a lot with Microsoft too, but that was the timing when mobile phone shifted to digital from analog architecture, and Nokia of course was the leader at that time, and we competed with TI in Nokia digital mobile business for a while. TI was very strong DSP supplier at the time. So TI chose ARM as a controller itself, and they combined that with their DSP, and that was a big defeat <laughs> because we lost Nokia business.

Fairbairn: To ARM?

Ito: To ARM.

Fairbairn: Through TI, right?

Ito: Through TI. That's one of the biggest reasons ARM became so successful.

Fairbairn: Changed history.

Ito: Yeah, changed history <laughs>. If that had not been the case, the picture would have been different.

Fairbairn: The people at ARM, Acorn at the time, designed the ARM chip using VTI's design tools.

Ito: Right. Yeah, ARM was the real successful IP supplier and their business model at that time was, I would say, very revolutionary business model. They made a big success.

Fairbairn: I did an oral history with the two primary designers of the ARM chip and one of the things that ARM is well known and has been successful is because it's so low power. I asked them what they did to keep the power so low and they had two answers. One was they knew they wanted to put it in a plastic package so they wanted to get the power as low as possible. So they paid a lot of attention to that in terms of trying to minimize it. At the time there were no design tools to tell them how much power they were going to use, so they always made the transistor size as small as they could. The other factor they said was they only had a small design team like four or five people so the design had to be very simple. So those are the two constraints, small design team and going to plastic package and the power ended up being 10% of what they had forecasted but it was only a goal because it had to go in the plastic package. They were designing it to be a processor for our computer for the next generation. It was only later that it got applied to embedded processor. It was accidental outcome of the development and personally driven by the fact that they had a very small design team. That was all the resources they had.

Ito: Very interesting. But in terms of chip performance, or low power performance and all that, I think SH and ARM were very similar. The one big difference was that we were the hardware supplier and we kept all these things as proprietary chips and technology and everything, and ARM, at the very early stage decided that they would be an IP supplier instead of chip supplier and that was the biggest difference.

Fairbairn: It was not an obvious decision at the time. Hitachi studied the RISC idea was relatively new and somewhat controversial at the time.

Ito: Oh of course, yes. Everything's different. The biggest difficulty of course was how to get customers to accept that. All the customers were familiar with the CISC architecture and the development environment and everything, compilers and so on, and so that was a big gap between them, and applying that RISC architecture to a controller world was very new at that time. Of course ARM was already working on that but they, at the very early stage, worked primarily as a computer microprocessor rather than a microcontroller. But I think Hitachi did a very good job. I was not a real hands on developer myself. I was rather in a management position at that time already. So, Kihara-san knows that very well. He was in the heart of that development.

Fairbairn: Who made that decision to go that direction?

Ito: There were several key people, including Kihara-san, and Makimoto-san was the real key person at that time deciding all these new architecture decision and everything.

Fairbairn: How long were you in management of the microcontroller?

Ito: I worked in that area for five to six years I think. I don't know if I was really an engineer or not, but <laughs> I was assigned in many, many different areas. Managing sales and controlling manufacturing and all these things then I was moved to Europe and U.S. to manage the branch companies there. So, as a real engineering work, I think I worked starting from 1970 through 1990 I would say, about 20 years, and after that I really moved to management positions.

Fairbairn: So your next step was to take on Renesas?

Ito: Yeah, I worked in Europe for two years to manage the factory there. Then I went to U.S. for one year to manage the sales operation there, and right after I came back from U.S., started to discuss about joint project, with Mitsubishi and started Renesas Technology in 2003.

Fairbairn: Getting back to Europe, where was the Hitachi factory?

Ito: At that time the factory was a semiconductor factory, and that was in a city called Landshut, near Munich, and that was originally a DRAM factory in Europe. But because of the DRAM downturn we had to shift from DRAM to other operations, so I was assigned to do that.

Fairbairn: Must've been very difficult. You set up for DRAM, not optimized for logic.

Ito: <laughs> Yeah, that was a good experience though, and then I moved to U.S. When I was working in U.S. the prime time of DRAM for Hitachi was over already, and I thought how Hitachi semiconductor operation should be. I was not in the position to decide that, but in my mind I decided that Hitachi should focus to microcontrollers, and after I came back from U.S. I talked with Dr. Nagasawa who was in charge of Mitsubishi semiconductor operation at that time, and we agreed between us why not getting out of the parent companies and set up a new company. We decided to join.

Fairbairn: So the reasons that Japan fell in terms of investment level or cost, what were the real driving forces of that?

Ito: In 1980s, and at least first half of 1990s for about 15 years, Japan led the business in DRAM because of technology. Technology competence was the very pure reason why Hitachi and all Japanese companies were so competitive. But after that, the technology as I said before, through equipment technology and material technology, became kind of global, I would say, infrastructure instead of proprietary I think, and technology could not be the core competitiveness anymore. The core of

competitiveness became more of the business decision, investment decision, all these things, and I think Samsung was very excellent in making up strategy in that kind of environment, and Japanese suppliers, including Hitachi, I would say, failed in making right decision in the right timing.

Fairbairn: Would they have needed to make bigger investments sooner?

Ito: The difficulty at that time was, as many people say, that investing in semiconductor or particularly in DRAM was very risky. I mean if you fail in timing or in scale, the damage will be very big. From the point of view of a more or less conservative company management culture, like Hitachi, Toshiba, all other Japanese players, that decision was actually very difficult. And particularly Samsung, even though they were already a very big company, was still more or less an owner management company. They made a very right decision taking risks, and the timing they invested was at the time of downturn, and in terms of timing, that was the right timing of course.

Fairbairn: Very difficult.

Ito: Very difficult. But for most of the Japanese companies, that was the difficult decision, starting investment at the timing of downturn when we are making a lot of negative figures.

Fairbairn: Difficult for any business, and the cost of building factories was escalating.

Ito: I think what happened was, instead of technology leadership, the strategic and management leadership became the core of competitiveness, and I think that was one of the biggest reasons why we lost.

Fairbairn: Did you realize that that was the problem at the time and was Renesas set up to address that problem?

Ito: Hitachi DRAM operation was spun out from Hitachi and joined a joint company with NEC, which was formed as Elpida. It was first NEC Hitachi Memory and then became Elpida. So when I came back from U.S., DRAM was not Hitachi business anymore, and I thought what would be the future picture for Hitachi semiconductor operation. Microcontroller, together with DRAM, since several years before that time, was the core competence. We were already a very major player in microcontroller and there were actually three major microcontroller players at that time in Japan, Hitachi, NEC and Mitsubishi. And I thought to become a real major player in microcontroller, it would be necessary for us to make some bigger joint venture. And joining with NEC was very difficult because we were competing too much <laughs> at that time. So I thought Mitsubishi would be the right choice and I came back and discussed with Dr. Nagasawa who was the head of Mitsubishi semiconductor operations, and we agreed between us, okay,

why not try. I think forming Renesas was the right decision. Many things happened after that, but still, making that company at that timing was a right thing to do.

Fairbairn: How did that turn out immediately? What worked and what didn't? What went well and what went as you expected?

Ito: After forming Renesas?

Fairbairn: Yes.

Ito: I would say, at the start, for four or five years, things went on a right track I think. But when I think about it, think it over, one of the problems - that was partly my fault probably, or a major portion - <laughs> was the lack of focus. We got out of memory business overall as Renesas, and we focused on microcontrollers, system LSIs. But still we covered almost all semiconductor areas except for memory. That was not enough as a focus. And as you know, after that, NEC joined in that venture later and Renesas became Renesas Electronics between Hitachi, Mitsubishi and NEC. In the last few years, Renesas converted, made a big shift to make a very strong focus to microcontrollers and particularly automotive business, and that was a very right thing to do. We should've done that sooner, I would say. We focused to non-memory business, but that was not enough as a focus.

Fairbairn: What size of DRAM was the last one that Renesas did?

Ito: The last one, that was I think 256 meg DRAM before Elpida started.

Fairbairn: Did you retire from full time management from Renesas?

Ito: I retired in 2008. When I started Renesas I took the position of President~~,~~ & COO. Dr. Nagasawa was the ~~c~~ Chairman & CEO, and I became Chairman & CEO after that, and in 2008 I retired.

Fairbairn: But still an adviser?

Ito: No. I worked as an adviser for couple of years but now I'm completely retired from that. I do many things without making any money <laughs>.

Fairbairn: You mentioned STEQ?

Ito: STEQ, S-T-E-Q. Yes. I started a venture with the name of STEQ, with a friend of mine, and that's in the fourth year now. we're still struggling <laughs>.

Fairbairn: Like a venture investing company?

Ito: No. ~~w~~e had investors to start the company, but not a venture investment company. The company is doing LED lighting module. Module technology is the core, basically.

Fairbairn: In general, Japan is not having the kind of success that it did previously. Do you agree and do you have ideas as to what might need to change?

Ito: In semiconductor or?

Fairbairn: In semiconductors and broader technology. During 1980s, the U.S. thought Japan would beat everybody and the world continues to change. The explosion in new applications and new technologies and focus on software and social media and so forth.

Ito: First, in the area of semiconductor, Japan is not really a leader anymore, but still can be competitive enough to add value to the industry. One of the problems we had in Japan, or one of the reasons why we failed, so to speak, was that we stayed as ~~a~~ general suppliers for too long, and the world industry changed at the very early timing to be dedicated special players, and all the successful players are specialized players in some way. Intel of course. Most of the successful players were like that, even TI, which now, instead of being a general semiconductor supplier, they are, I would say, analog company and Infineon became a power device company. All the semiconductor suppliers in the world are, in some way, dedicated in some special areas, and in the last three or four years, Japan finally got to that point, more or less. Renesas is now ~~a~~ in automotive microcontroller, real time controller business. It's a very clear dedication right now and Toshiba is a dedicated flash memory supplier and Sony is an image sensor supplier. And in that sense, I think we are now finally in some management system which is, I would say, global standard, and each of these companies has its own competence. I think Renesas is strong enough in that specialized area today and Toshiba of course, and Sony is almost covering most of the worldwide share in image sensors. So by that way, more and more clearly, Japan would be okay. I don't think Japan would dominate the business anymore as we had done some time ago in very special DRAM area. But pursuing this way is on the right track I think. The thing we need to think about is that we are still not very good at envisioning long time future. Japanese way of thinking is more like continuity rather than jump <laughs>.

Fairbairn: I don't think any established company is very good at envisioning the future. The U.S. success has come from the ability to form new companies to pursue new things. The established companies are never the ones to pursue new areas. You can't change or move fast enough to adapt.

Ito: But I think that's the strength of U.S. That's a combination of big established companies and the new ventures which create a new future, and a very good combination of these two creates competitiveness of U.S. industry overall. But in Japan we are still not very good on this side. Growing new ventures, envisioning the future. But I think that's also starting. The problem we have is that we still do not have good venture funds. So even though there are good ideas and good young people there, not enough monetary support yet, I would say.

Fairbairn: It requires full infrastructure in terms of the whole startup culture. In terms of envisioning the future, as part of doing this, we were celebrating some people who have made contributions in the entrepreneurial area. When we were interviewing Gordon Moore for this, he made the comment that when they had finally figured out how to make the integrated circuit the first time and how to put the pieces together and get it somewhat reliable and manufacturable, they sat back and said "Okay we did that, what's next?" and here they had created the basis for 50 years of explosion of technology and they had no idea what they had created. Here's the ultimate invention of the 20th century and the people who did it had no clue as to what the impact of what they had just done, and that is so common. It's so hard to understand the impact. Envisioning the future and planning the future is very hard.

Ito: As long as the future is envisioned, we are very, very strong. In automotive business area, for example. Everything is continuous, though. <laughs>.

Fairbairn: As long as the future is incremental then you know how to do that, right? But when the future is discontinuous, you need that entrepreneur, that one person to go off and just do it, right, and the one who sees what that is.

Ito: The great America is that you succeed in establishing both sides of it, you know, jump and continuity. Japan is very good on this side, but <laughs> we still need to do something about the other side.

Fairbairn: You're not the only one struggling what to figure out what's next. What's next is very hard to predict.

Ito: Makimoto-san by the way is a very good visionary. So, he envisioned many good things like SH, H-8 and all these things and yeah, we need to do that.

Fairbairn: We're winding out. Do you have any other thing you'd like to add?

Ito: Well, no. Thank you very much for giving me this opportunity and very honored.

Fairbairn: Well we are honored as well and thank you very much for taking the time and we appreciate all the help that you've also provided in lining up the other interviews. I think the selection of candidates has been excellent.

Ito: Thank you very much.

Fairbairn: It's a very broad cross section of some people who have made significant contributions, each by their own path…

Ito: Yeah I think the selection this time was good I think.

Fairbairn: Yeah I'm very impressed.

Ito: Tani-san helps us quite a bit.

Fairbairn: Anyway, thank you very much.

END OF INTERVIEW

