Oral History of Toshimasa Kihara

Interviewed by:
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Douglas Fairbairn: Okay. Welcome. We're in the New Otani Hotel in Tokyo, Japan. It is June 21st, 2016. I'm Doug Fairborn, and I'm talking with Toshimasa Kihara, yes?

Toshiaki Kihara: Yes.

Fairbairn: And very glad to have you here. Welcome.

Kihara: Thank you for this opportunity.

Fairbairn: And as we were talking before, we are looking forward to capturing the stories of people who have made important contributions to the semiconductor and computing world that we live in. And so we're delighted to have you with us. Before we get into the details of your career and some of the things you've done, we always like to start with understanding your background and how you grew up and what your family life was like, and especially understanding what influences and what things might have steered you in the direction of technology. So if you could start and just tell us a little bit about when and where you were born and a little bit about your family, what your father and mother were engaged in, if you have brothers and sisters, if they followed a similar path. So why don't you just start with that and tell us a little bit about your early family life?

Kihara: Okay. I was born in 1946. In Yamaguchi Prefecture, which is located at the very southwest end of Honshu Island. It's about 500 miles away from Tokyo. And my father was an ordinary employee of an Electric Company.

Fairbairn: Of the what?

Kihara: Electric Company.

Fairbairn: Electric Company, uh-huh.

Kihara: Yeah. And my mother was a schoolteacher before I was born. And I have three brothers, all boys. And I am the eldest. And one of my brothers became the government officer of the Internal Affairs.

Fairbairn: Internal Affairs? Yeah, uh-huh.

Kihara: Yeah, yeah. Government officer, anyway. And the other brother became the engineer, engineer in the field of the numerical controls and robotics. By the way, the government officer, he was technical officer, so all three of us have chosen kind of the science type. And my father didn't talk much directly to me unless I did something wrong. When I did something wrong, he strongly instructed not to do that.

<laughter>

Fairbairn: So you had a lot of negative feedback.

<laughter>

Kihara: Although, you know, he didn't talk much, and well, he was very typical father in the family <laughs> in Japan <laughs> in those days.

Fairbairn: Mm-hm. Had he gone to university?

Kihara: No. I don't think so. There were no universities at that time in the countryside. Ah, yeah, there were, but no. And my uncle, my aunt, they lived nearby of my home. And two of them were the young schoolteachers. So I was sort of surrounded by the schoolteachers. And I was the first child in the family, so you can imagine what happened, you know.

<laughter>

Kihara: They gave me kind of private lessons. They gave me, Uncle gave me, the private lesson on English every week or… And they took me out to the field or mountains for plant collections to learn nature. So I don't remember any specific which made me <laughs> to go to the scientific world, but somehow, yeah. Both of those, the teachers, my uncle, aunt, they majored in the biology. So maybe something science. <laughs>

Fairbairn: Certainly scientific thinking in conversations with them

<laughter>

Kihara: <Inaudible>. [Those are] kind of family matter.

Fairbairn: Mm-hm. So you entered the University of Tokyo?

Kihara: Yes. Before that, I remember that when I was in elementary school or the high school, junior high school at that time, the Sputnik that Russia, Soviet Union, they launched the rocket. That was the, you know, big thing for the schoolboys. And that's… I was, we talked about a lot, that rocket or planet or space. And galaxy. I'm very sure that we didn't understand anything.

<laughter>

Kihara: About those things, but we just talked.

<laughter>

Fairbairn: I was inspired by the same thing.

Kihara: Oh, is it? <laughs>

Fairbairn: The Sputnik. And I was following all of the developments of The Space Race very closely and…

Kihara: <laughs>

Fairbairn: So that's the--

Kihara: Yeah, yeah, same here. Yeah, yeah.

Fairbairn: --same thing that got me going. <laughs>

Kihara: And we were curious, curious about space, especially beyond the galaxy, you know. If you go up, then you go to the galaxy area, then what are there?

<laughter>

Kihara: And we realized that something, you know, infinite galaxies. And what I clearly remember is that I personally felt very much scary, you know, infinite years. I couldn't digest, "What is infinite?"

Fairbairn: What is infinite?

<laughter>

Fairbairn: None of us can quite digest what is infinite?

<laughter>

Kihara: Even now, but yet it was very scary. I remember that <inaudible> there. And also for Japanese, the first Nobel Prize winner in Japan was Professor Yukawa. He was the theoretical physicist. And the schoolteachers very much admired that professor. And they said that, "Professor Yukawa is the hero, the hero of not just in the scientific world but the hero of Japan." <laughs>

Fairbairn: Ah. What university was he at?

Kihara: What?

Fairbairn: What university? He's professor at what university?

Kihara: Kyoto I think.

Fairbairn: Kyoto?

Kihara: Yeah. But when I was in the junior, it was-- maybe I was in the elementary school or maybe junior high school. So we didn't, I didn't understand which is which, but… <laughs> But we just thought that the scientist is the hero. <laughs>

Fairbairn: Yeah, the hero.

<laughter>

Kihara: Hero of the country in Japan, so…

Fairbairn: Yeah, yeah.

Kihara: Those made me, those inspired me a lot. And steered me to the direction of science or technology. So when I went to the university, the University of Tokyo, there were six [courses] to choose. One is-- three in the science and three for politicians and economist kind of things, but I have chosen scientific, science world side. <laughs> But I was not ready to pin down my major.

<laughter>

Kihara: When I entered university. The good thing was that the University of Tokyo didn't require to pin down the major until the second year, the end of the second year. So that's one of the reasons why. You know, I had chosen the University of Tokyo. And also, the University of Tokyo was considered to be the number one, you know, in terms of its quality. And another reason is that that university is located in Tokyo. Tokyo was very attractive, you know. <laughs> The student life in Tokyo was very much attractive for the schoolboy. <laughs> I was born in, and raised in, the small local town, so… <laughs>

Fairbairn: Ah. So you were excited to go to the big city, huh?

Kihara: <laughs> Oh, yes.

<laughter>

Kihara: Thought it must be, you know--

Fairbairn: Yes.

Kihara: worthwhile to live there, so… anyway, I have chosen the University Tokyo and--

Fairbairn: So at University of Tokyo or others, do they have dormitories, on-site housing for students like we do in the United States? What's the--

Kihara: Yes.

Fairbairn: --living situation?

Kihara: There were. They had dormitories. Nowadays, now, I think that they had taken away those dormitories. They don't have now, but yes, they had when I entered there. And half of the student lived

there, and the other half not there. I didn't live there, but I stayed there <laughs> with my friend, lived there. And I lived outside of the dormitory but…

Fairbairn: So you had to commute to school?

Kihara: Yeah. But very near. I mean, 10 minutes' walk or something.

Fairbairn: Oh, okay.

Kihara: Yeah.

Fairbairn: So very close.

Kihara: Yeah. And--

Fairbairn: But you hung around school with your friends.

Kihara: Yeah, very much.

Fairbairn: <laughs>

Kihara: And even stayed in the dormitory.

Fairbairn: Stayed in their rooms.

Kihara: Yeah.

<laughter>

Kihara: Quite often.

<laughter>

Kihara: It was very fun. Yeah.

Fairbairn: So you--

Kihara: Good memory out of.

Fairbairn: So you were there and you finally decided to study applied physics?

Kihara: Yes, applied physics course for the second half of the college time. And for the graduate school as well, the same, applied physics.

Fairbairn: When did you enter the university? What year did you enter?

Kihara: It was ’65. And graduated in ’69. And finished master’s course in ’71, so…

Fairbairn: Mm-hm. And then you immediately went to--

Kihara: Hitachi.

Fairbairn: --work at Hitachi.

Kihara: Yes.

Fairbairn: And how did you choose Hitachi? Why?

Kihara: Mm, well, good question.

<laughter>

Kihara: Well, didn’t have good consideration. One, that Hitachi was considered to be the most technology-oriented company. And there were former classmates already working or senior classmates. Many of them working already there. And I, before I went to Hitachi, I, you know, communicated to those, you know, my classmate there, and they said that, “Yeah, Hitachi is the good place.” <laughs> And they said that Hitachi values the technology and engineers the most. But company have to… <laughs> I

realized afterward that the company have to be, you know, profitable, so… <laughs> Anyway I thought it's a good message, you know. The company value you and technology the most. So that's the reason why.

Fairbairn: Good. So did you know you wanted to get into semiconductors? Had you done work in that in your master's program or had you--

Kihara: I did choose the semiconductor area for my thesis. But the professors said that silicon was no more interesting, attractive enough, from the material science point of view. It's--

Fairbairn: You say it was not attractive?

Kihara: Not attractive.

Fairbairn: Uh-huh.

Kihara: It's already well, you know, investigated.

Fairbairn: Well understood and--

Kihara: Well understood.

Fairbairn: --characterized.

Kihara: And characterized. And they recommended to me to choose the compound semiconducting materials like cadmium telluride or cadmium sulfur, all those kind of the compound semiconductors. And the researchers at the graduate school at the university, they guided me to do the experiments or to do measurement of those materials. And to do the computer simulations. And to analyze the electron band structure or do some research on interactions between electrons and phonons. So I did all those kinds of things. And so that's sort of the semiconductor area, but… <laughs>

Fairbairn: That was your background when you went to Hitachi.

Kihara: Background. <laughs> And what I thought, at that time, when I was doing those research work at the college, or graduate school, I was not necessarily very much good at those lab works. It was

necessary to grow the single crystal to begin with and make the samples for the measurement. To purify those materials. And I thought that this might not be the one which, you know, I have to choose.

<laughter>

Kihara: So yeah. At that time when I entered the company, in Hitachi, many of [of my friends] went to the central laboratories. Laboratories of Hitachi . And I was advised to go there. That's natural path. But I thought that lab work might not be the area where I should go. And I dared to choose the semiconductor business group, without knowing what is the ICs or…

<laughter>

Kihara: What is the computers or whatever. <laughs> But yet I have chosen the semiconductor business group of Hitachi <inaudible>. There were, you know, my classmates also working there. Yes. I have a good reason why I've chosen the semiconductor area. And I have personal reason to choose the business side instead of the laboratories.

Fairbairn: Mm-hm. So did you look at other companies? What were the other, like, NEC or Fujitsu or…

Kihara: Mm, actually, <laughs> actually, no. You may remember that that's the time of the student movement.

Fairbairn: Yes.

Kihara: So we are not very much serious about the, you know, working or something.

<laughter>

Kihara: Just discussing or just, you know, in some case shared ~~the~~ time with my friends or with the faculty members. And we don't have, I didn't have, a special interest in choosing company to join. But I found that it's time to finalize my choice. A late, it was a late… It's late autumn, the graduation. Graduation is March, so it's almost time. <laughs> You have to fix your choice.

Fairbairn: <Inaudible>.

Kihara: --<inaudible>, so… <laughs> <inaudible>. And then my friend there say, "Why don't you come to Hitachi?" <laughs> "Okay." <laughs> That was easy. <laughs>

Fairbairn: So what was the state of semiconductors within Hitachi? Was it still a small part of the business at that time; is that right?

Kihara: It's relatively small, but just, mm, mm, yeah. Compared to the whole Hitachi business, other business unit, the semiconductor was very small. They actually, when I took some interview [at Hitachi] before hired by Hitachi, I was asked, "Why you don't choose mainframe computer?" "Or like the power, the nuclear power <laughs> generation? They are, two of those, are the major focus of the company." <laughs>

Fairbairn: Right.

Kihara: But mainly because I didn't have any of the classmates over there, so… <laughs>

Fairbairn: Yeah. All your friends were over here.

Kihara: Yeah. I have many friends here.

<laughter>

Kihara: I have chosen the semiconductor. I think that it was relatively small in terms of the size of the business, so yeah, just…

Fairbairn: So what was your first job or activity within Hitachi? What did you start with?

Kihara: I was engaged in the designs. Designs, you know. I did design the custom LSI for the calculators. I did design of the shift register chip, and the--

Fairbairn: Are you doing circuit design?

Kihara: Circuit design and layout design.

Fairbairn: Oh. You did everything, huh?

<laughter>

Kihara: For that shift register. For the calculator case, mainly layout design. And EPROM memories. And also I did the design of the 4-bit microcomputer chip for this case logic as well. So…

Fairbairn: You did the logic design for it?

Kihara: Yeah, for those. So I did quite a wide range of the product lines, memory, <laughs> custom chip. <laughs> And also, technology-wise, I did the yield improvement or failure analysis, to improve the yield. So I did quite wide range of the technologies and the product line as well. It was very good, you know, <inaudible>. It was possible at that time, since, you know, each product or each project size was relatively small. So of course I got some, you know, guidance from my boss. But I could have had a kind of hands-on experience. It was very helpful [for my career].

Fairbairn: Yeah. One person could do everything with some of the smaller chips.

Kihara: Yeah, yeah, at that time, yeah.

Fairbairn: So when you're doing microcomputer design, this is in the very early days. I mean, Intel did--

Kihara: Four-bit.

Fairbairn: Just did the 4-bit.

Kihara: Yeah, yeah. Yeah. I did the 4-bit, design of the 4-bit microcomputer, which is compatible with the Intel.

Fairbairn: So okay. So that was your reference design, so you knew what…

Kihara: Yeah, yeah. And at that time there were no knowledge in the semiconductor group of Hitachi about the, knowledge about the computer, I mean, the computer engineering. So I visited the laboratories, which is corporate laboratories, laboratory, independent of the semiconductor business unit. And they did the research on computers. Hitachi had mainframe business units. So there were many researchers there. And so I got, you know, advice or lessons from those guys, and I learned about what is computer.

Fairbairn: What year did you work on the 4-bit microcomputer?

Kihara: Oh. It's '70-- I'm not sure, '74 or '73, about that time frame, I think.

Fairbairn: So it was still a very [new] technology and a very new idea.

Kihara: It was very new at that time.

Fairbairn: Many people didn't understand at that time what it would be good for or what the applications were.

Kihara: Yeah. As a matter of fact, what I developed was the 4-bit chip, which is compatible with the Intel [chip],-there ~~was~~ no good business there.

<laughter>

Kihara: Actually, there were no customers.

Fairbairn: Yeah.

<laughter>

Kihara: But what's interesting is that, the computer, I mean, the 4-bit, it was 4-bit but it's parallel processing. But the calculator chip is serial, so there are clear differences in terms of the hardware architecture. It was interesting. Yeah.

Fairbairn: So did Hitachi start working on that, or they wanted you to do that because they said, you know, Intel was doing it and they wanted to go. I mean, with that clear application, I was just wondering, what was the driving force? Because Intel actually did it, they didn't know what they were doing either. They were just going to make a calculator, use it as a programmable calculator, right?

Kihara: <laughs> Yes, true.

Fairbairn: Did you have any, do you know what the--

Kihara: Actually, you know, I was told to do that.

Fairbairn: You were. <laughs>

Kihara: By my boss.

Fairbairn: Yeah.

Kihara: So… But company at that time was always ~~very~~, you know, paying attention to all kinds of new technologies in general. And yeah, that microcomputer was, you know, one of the hot topics in the industry, so that might be why.

Fairbairn: What about support software and that sort of thing? Was the goal just to use what Intel did or did you start developing compilers and other things to go…

Kihara: You know, in the case of the 4-bit, the customer did not require that, just the assembler was used . And… I don't know whether there were any compiler or debugging tools in the market, so…

Fairbairn: You didn't, I mean, Hitachi was not working on those things.

Kihara: Mm, they did some work, I guess, somewhere, but at least it was not the, you know, substantial activity there.

Fairbairn: Right.

Kihara: We did software development a lot for the 8-bit, yes. Or for our own RISC architectures. I know that those are much more burdensome, resource eating than the chip designs <laughs> I mean, the whole support ecosystem was, you know, the big focus. But for that 4-bit it was not the case.

Fairbairn: So how did things work out with your first chip? Did it work the first time or what was your experience doing this 4-bit computer?

Kihara: <laughs> The first chip worked well. What I remember at that time, there were no simulator software simulator there, logic simulator. So what I did is mockup – made of TTLs.

Fairbairn: Yes.

Kihara: And using the all those TTL, you know, we built the huge circuitry.

Fairbairn: Oh, you built a breadboard.

Kihara: Breadboard. Yeah. <laughs> Mockup breadboard. And yeah, yes. You know, finally I did it that it's working.

<laughter>

Kihara: Then, you know, the engineers came from the various locations where they were doing the calculator chip design or memory chip design. They didn't know anything about microcomputer chip, so <laughs> yeah,I explained "this is the computer chip".

<laughter>

Fairbairn: How did you even test it? I mean, you needed to--

Kihara: I developed a test program using the breadboard. I developed some, you know, simple program. I made it, I mean, made some computer program. What I did is for the CPU portion only. But I did some test programs and used that program to test whether the CPU's working or not. And yeah, just lamp, periodical lamp lighting test program or something simple.

Fairbairn: Mm-hm. Mm-hm. Had you ever written software before? Had you ever written a program?

Kihara: I didn't have any experience. It was before I studied the, you know-- <laughs>

Fairbairn: Computer science.

Kihara: --computer science at <inaudible>, so… But yeah. But I did the computer simulation for the material science, when I was an university student.

Fairbairn: Oh, okay.

Kihara: So I did some, you know, programming. But that was not the assembler kind of things, yeah. Other high level languages.

Fairbairn: So did you see what the potential was of this microcontroller you were designing? Did you get excited about that or was it just one of the jobs that you were assigned?

Kihara: I thought, "This is the one which I have to do." <laughs> Actually, I remember I wrote some kind of a research paper, report. I have that copy but I think that my boss may have said that, "You do this," or something, The report is about the evaluation of the computer architectures and comparisons. I have chosen the Intel, 8-bit, and the Motorola 8-bit. And also…

Fairbairn: Is this the 8080 and the 6800?

Kihara: 8080 and 6800.

Fairbairn: Okay.

Kihara: And there were research activity in place at that time for our own 8-bit microcomputer.

Fairbairn: Yes.

Kihara: And what I did is to evaluate each of them in terms of its performance or in terms of the functionality and future expandability, you know, if it was necessary to expand the instruction set or register structure or whatever in the future. So I did all those analyses. And I evaluated three of them. And I concluded that, "Ours is the best."

<laughter>

Kihara: And that report was for the company, not issued outside of the company, but distributed in the company. And then--

Fairbairn: The report was distributed within the company, yeah.

Kihara: Yeah. And then the memo came down <laughs> from the top management of the semiconductor group at that time. Which says that, "This report is wrong. Wrong."

<laughter>

Kihara: "This report is wrong because that it underestimates the importance of the software compatibility." That's the most essential for the computer type, you know, business.

Fairbairn: You say you underestimated the importance?

Kihara: I underestimated.

Fairbairn: Underestimated the importance. So you said yours was best on a technical merit, but didn't consider enough the software compatibility.

Kihara: Yes. Yes. <laughs>

Fairbairn: Had your product, the Hitachi product, been designed in one of the research groups?

Kihara: In research group. And it had something to do with the, yeah, future application in the automotive engine. Hitachi had an automotive electronics division, I mean, business group. So probably there were some plan in place. And the research group who was doing this, you know, planning of the product. Again, by the way, that's microprogram control. <laughs> And yeah, our architecture was ~~that~~ good, but…

Fairbairn: Mm-hm. So when did you write this report? What year was it, do you remember?

Kihara: '74 or something, '74 or '5. Yeah, I do have the report.

Fairbairn: Oh, you do?

Kihara: Yeah.

<laughter>

Kihara: Since, you know, [I was told] "This is wrong."

<laughter>

Fairbairn: So how did you feel? Did you agree with their…

Kihara: Yeah, yeah. No. Yeah.

Fairbairn: Did you…

Kihara: Yeah. I understood how important it is to be compatible. Yeah. Software is so important for the computer business. It was a case in the mainframe area or in the mini computer area. The software, I mean, the architecture became standardized in the industry. And I was not very much familiar with those trend, but, you know, if I sit down and think about that, it's very much understandable software <laughs> must be first for this kind of ~~a~~ product.

Fairbairn: So what was the result of that? Did they change plans or what directions or how did it influence you or…

Kihara: What's that?

Fairbairn: When that report came down, what was the impact?

Kihara: After that or…

Fairbairn: Mm-hm.

Kihara: After that, I was told to go to Motorola. The management~~,~~ [had already] decided to license the technology from Motorola, and I was delegated to Motorola, Motorola's team. Probably for a few weeks to get the technology of the product transferred. I was just alone there, so… It was good [memory for me], by the way.

Fairbairn: Mm-hm.

<laughter>

Fairbairn: Okay. So they told you to go to Motorola and how was that received? Was Motorola willing to do a license? And what specifically were you looking for?

Kihara: That was, you know, the licensing the agreement was in place. I mean, was made before, of course, before I went there. And there was agreement that the technology wasbto be transferred from Motorola.

Fairbairn: So was that to get the exact chip or to just make a software compatible product? What was the--

Kihara: The product itself. The processors, I mean, the CPUs.

Fairbairn: You're going to transfer it directly.

Kihara: They transfer to us.

Fairbairn: Okay. All the design material and--

Kihara: And we make the--

Fairbairn: --masks and everything?

Kihara: Yeah, everything.

Fairbairn: Yeah.

Kihara: And we developed the peripherals.

Fairbairn: Okay.

Kihara: Like peripheral controllers. Like a floppy disk controllers or DMA and--

Fairbairn: So was the agreement that they would give you the processor and then you would develop peripheral chips that would go back to them?

Kihara: Yes. And also some, you know, the CMOS technologies transferred.

Fairbairn: Oh, okay.

Kihara: As well, I think, yeah. It's quite a big agreement - the arrangement there in place. And my mission is to get the CPU transferred <laughs> from there.

Fairbairn: So your mission was to go get it and bring it. And were they cooperative. Did you…

Kihara: They were very much cooperative. Yeah. They were typical Texas guys.

<laughter>

Kihara: So I had a good time with them. Yeah.

Fairbairn: How long did you spend in Austin?

Kihara: A few weeks. I don't have the exact, you know, number, but… I stayed in a small hotel outside of the city. And since I couldn't drive, so they took me every day [to their office].

<laughter>

Kihara: In the morning. And brought me to the, for my dinner there. <laughs> So it was nice. Yeah.

Fairbairn: Mm-hm. So you transferred the technology back. Was Hitachi able to get the product into production quickly? How?

Kihara: Yeah, it was very quick for us to make it and do business with, but from the engineer's point of view or even from the manager's point of view, doing business with the plug-compatible machine, <laughs> with no differentiation was no fun. So we tried to make the processor differentiated from Motorola, and we did the CMOS design on those. And also the EPROM integration into the microcomputer chip, which is today's main topic. But we tried to differentiate.

Fairbairn: Is EPROM--

Kihara: EPROM.

Fairbairn: EPROM.

Kihara: We replaced the masked ROM in the chip by the EPROM, so--

Fairbairn: Did that then have to be transferred back to Motorola? Or was that your own--

Kihara: That wasn't-- It was not transferred as a reality. But I understand that Hitachi was ready to do that, but.

Fairbairn: Mm-hmm. Motorola may not have had the EPROM process.

Kihara: If they want to do that, they could do that I think. But that was sort of the NIH mind, “Not Invented Here.”

Fairbairn: Yes.

Kihara: Especially in Texas.

<laughter>

Fairbairn: Especially in Texas. <laughs> Yes.

Kihara: I don't know. I don't know. But I can, I just--

Fairbairn: It's a fair. It's a fair common--

Kihara: I can understand very much, yeah.

<laughter>

Kihara: We have had the same feeling, you know. We’d rather focus on our own, you know. <laughs>

Fairbairn: Yes.

Kihara: Not what we got from someone else, so.

Fairbairn: Right.

Kihara: Kind of, yeah, so--

Fairbairn: So did you then begin development of your own 8-bit processor in addition to second sourcing the 6800?

Kihara: You know, for a while, we focused on developing the fully software compatible, but CMOS and EPROM integrated. And it was very well accepted by the customer, by the way. And I believe that we did contribute to expand the Motorola architecture [in the market]. But there were some, you know, conflicts in the market around two companies. And some negotiation done there, and then we decided to go to the, you know, new architecture, different from the Motorola. It was very tough for us to go to the different architecture. So what we thought that trying to compete against the Motorola architecture in the assembler language level [is not wise strategy]. Instead, we thought that the, you know, market have to go to the C language. So we tried to make the good hardware architecture which fits to the C compiler most. And we released those products. We called it H8 Series, by the way. And that was a time that the market is going from the assembler to C compiler, I mean the C languages. So the timing was very good, and we strongly promoted that. We guided our customer base, "let's go to the C language which should be the way how you can, you know, improve your burden-- I mean—

Fairbairn: Productivity.

Kihara: Reduce your burden….

Fairbairn: Yeah.

Kihara: …by using the high level languages. And our compiler is, you know, efficient, so don't worry about it. And the speed-- I mean, the performance is good enough to cover-- to compensate the degradation caused by applying the high level languages.

Fairbairn: So before you got involved in all of that, though, you took a year and went to Stanford, is that right?

Kihara: At Stanford, the-- Yes, all those things like development of the CMOS version was after I came back <laughs> from Stanford, yeah.

Fairbairn: Okay. After you came back from Stanford?

Kihara: Yeah. From the campus.

Fairbairn: So you had transferred the technology for the original processor and then sometime after that, you went to Stanford and got a master's degree in computer science.

Kihara: Yes.

Fairbairn: And what-- is there some important-- is there some specific things that you learned in that year that you could later apply? Or was it just sort of general, basic understanding or better understanding of computer science that made you able to be a better contributor in the microcomputer space? Was there any-- Did it change your mind or make you take a different direction?

Kihara: Yeah, yeah. I know that. I cannot think about the specific things, but the-- it was very nice for me to deepen my understanding about the computer in a very systematic manner, you know. I did that piece by piece [at Hitachi beforehand].

Fairbairn: Yes.

Kihara: But it was not very much very well organized.

Fairbairn: Right. You didn't have the total perspective.

Kihara: Yeah.

Fairbairn: So you studied computer architecture as well as software development and--

Kihara: I didn't do many software in the study at the Stanford. More hardware.

Fairbairn: More hardware.

Kihara: Yeah.

Fairbairn: Okay.

Kihara: At that time. But yeah, I do some, yes, software, so.

Fairbairn: So you came back-- you went to Stanford in '78?

Kihara: '77.

Fairbairn: '77.

Kihara: '77 to '78. So and just after that, we as a company did the development of the CMOS version, but the-- Yeah, I think-- Yes, yeah. And the EPROM, I mean, non-volatile memory integration is after the CMOS version development which was in the middle of the eighties, so a few years later, after we introduced the CMOS version.

Fairbairn: How much later?

Kihara: A few years later.

Fairbairn: A few years later.

Kihara: Yeah.

Fairbairn: Uh-huh.

Kihara: Eighty-something. I have to check.

Fairbairn: Okay. So when you came back from Stanford, what was the focus of your own personal activity? What projects were you engaged in at that point? And had the decision been made when you came back to develop your own architecture? Or was that something that you did when you came back?

Kihara: The microcomputer chip business <laughs>. So what I focused on was from that time, you know, the microcomputer chip business, the product development. And afterward, the business by those products, yes.

Fairbairn: Mm-hmm. But when you came back from Stanford, had Hitachi already decided to develop their own architecture? Or was that something that you helped guide when you got back?

Kihara: When I came back from Stanford, Hitachi's strategy was to stay fully software compatible.

Fairbairn: Okay.

Kihara: Meaning that it was not the priority, to develop and provide the [new] architecture.

Fairbairn: Right.

Kihara: Yeah.

Fairbairn: So it was some time after that. Do you remember when that decision, did you participate or did you drive that decision to--

Kihara: I was a-- I participated <laughs> a lot. There were some issues raised by Motorola. If we continued developing and doing biz with the software compatible, but the CMOS or field program device technologies integrated [products], that's, you know, what-- that's not what they intended at the beginning when they did the arrangement.

Fairbairn: Right.

Kihara: So we needed to do something there to resolve the situation. That's one reason. And the other is, you know,-we thought that the, as I said, the people are moving to the C language-- I mean, the high level languages from the assembler.

Fairbairn: Right.

Kihara: So we thought that it's time ~~to~~, let's do that way.

Fairbairn: Right.

Kihara: And yeah, let me see. What's that? I have to check. Let me check. So it's '88. '88. So I think that the controversial discussion started in the middle of the eighties, so five years or more after we introduced the technology from Motorola. We felt that we have to do something to, you know, resolve this and differentiate.

Fairbairn: You had to differentiate your-- Right.

Kihara: And not just, you know, Motorola-compatible only, but do something. And we introduced our [proprietary] product in '88.

Fairbairn: So what was the, in the first processor of your own architecture, what were the most important characteristics? Were you looking for higher performance? Were you looking for more flexibility? What was the-- what was going to be the selling point for that processor versus the 6800 family, for example?

Kihara: The best architecture, if the customer use C compiler there. The H8 was designed in such a way that the instruction set is symmetric and the registers are general registers. No specificality there. And we did the-- There was the microprogramming, by the way, inside. And we did some pipelining technique to speed up. So, you know, our goal is to do this way that the customers may not have concern about losing the performance--

Fairbairn: Mm-hmm. Because of the C compiler.

Kihara: The C compiler.

Fairbairn: Yeah.

Kihara: But as far as ours is concerned, no degradation of the performance, if you can— even if you use the C compiler. So that was our, you know, goal. And we said that to the customer. And so it was it worked very well. And in addition, we had a ZTAT technology integrated in that.

Fairbairn: Zero turnaround time.

Kihara: Zero-- <laughs> sorry.

Fairbairn: Right.

Kihara: Zero turnaround time, which is field programmable.

Fairbairn: And this is using EPROM technology, is that there usually?

Kihara: Yeah. The ZTAT we started from EPROM, and for those days, we moved to Flash. And furthermore, we expanded this concept to the peripherals. And we made the peripheral function of that chip programmable.

Fairbairn: I see.

Kihara: And we named it Intelligent ZTAT. So the first one is ZTAT. When we moved to the Flash, FZTAT.

<laughter>

Kihara: And now then, the-- What's the other one? Okay, let's make it Intelligent.

<laughter>

Kihara: I-ZTAT. So field programmability was our differentiation. Yeah.

Fairbairn: And that was-- What were the target markets for these products at the time?

Kihara: The controller application. We didn't try to attack the data processing world where the software compatibility was very crucial with Intel. Actually, we developed another version using the same, the microprogramming CPU, but we made it a Zilog chip upward compatible.

Fairbairn: Oh, okay.

Kihara: The chip itself is the same, but we reprogrammed.

Fairbairn: Right.

Kihara: And we tried to make it the engine for ~~the~~ CP/M Plus. There was some trend there. Digital Research. We did some collaboration with them and we made the chip which is intended for the data processing application. We gave the name to that processor, leading data processor, LDP.

Fairbairn: LDP, yeah.

<laughter>

Kihara: And yeah, we did some good business with that. Actually, we licensed that to Zilog.

Fairbairn: Oh, okay.

Kihara: Yeah. [In order to avoid] any [risk of] future, you know, controversial dispute with Zilog

Fairbairn: So did you have any legal problems with Motorola?

Kihara: We had the contractual dispute for a while starting from the middle of the eighties or something. And eventually we went to the court in that legal dispute in the end of the eighties. It was something.

Fairbairn: How was it resolved?

Kihara: They sued us by the patent infringement and we sued back.

Fairbairn: Sure.

Kihara: With their patent infringement.

Fairbairn: Right.

Kihara: And it took like one year. But the judge, finally he said that, <laughs> you do compromise.

Fairbairn: You figure it out, huh?

<laughter>

Fairbairn: So did you just cross-license your--

Kihara: Some monetary kind of things also, but, yeah. It was '89 or '90 or something. That's one of the reasons why we developed the other new architecture which is SuperH which is a RISC machine. Again, we didn't want any dispute <laughs> with Motorola or whoever. And so we tried to make it totally new. And it was a good time, by the way. At that time, the new wave of the digital consumers, and digital consumer equipments coming. Like digital camera or car navigation systems, TV game machines, all those. So it was good timing for us to introduce a brand new processor. There were no, you know, legacies there of software. So we developed new--

Fairbairn: So when was that introduced?

Kihara: It's '92. So we did start this development in the late '80s. And the legal disputes helped us, you know, in one sense, to accelerate <laughs> that development of that project.

Fairbairn: Right. So during the mid-eighties, there was a lot of talk about RISC processors. How did that influence any of the work that you did? Did you incorporate RISC technology in your new processors? Or how did that-- Anything happen there?

Kihara: There were yeah, like a MIPS--

Fairbairn: Oh, the ARM and the MIPS and the SPARC and there were several--

Kihara: Yeah, SPARCs. And the-- There were options to introduce that, you know, architecture for us. But we didn't do that.

Fairbairn: You didn't pursue that.

Kihara: No.

Fairbairn: Yeah.

Kihara: The one that we didn't want to repeat the same issue in the future. <laughs> And more importantly, we have a good technology <laughs> available inside and we thought that we can succeed in doing business even though ours is-- I mean, the proprietary as far as it's attractive enough, so we thought we can--

Fairbairn: Now, you said in '92, that RISC microcomputers and microprocessors were in digital consumer use, did you incorporate the technology then?

Kihara: Yes. Yes. That's what I am talking about.

Fairbairn: Okay.

Kihara: That's the one. We just called it new RISC machine. It's a RISC machine tuned, targeted to the digital consumer electronics.

Fairbairn: Right, right.

Kihara: So what we most, we paid attention most is the code size efficiency, since it's gonna be embedded. So the memory size is the issue. And we did some good collaboration with our software researchers, I mean the engineers, who were not our engineers, but at the corporate, Hitachi has the software research laboratories. And we were closely allied with those people from the very beginning for the instruction definitions or register structures. And they did good work to develop the good C compiler, since we had been communicating from the beginning.

Fairbairn: Right.

Kihara: The top management of that laboratory, by the way, was very much cooperative and he visited us in person <laughs> for the specific, you know, architectural designs and gave us suggestions, and of course, he allocated good engineers [for our RISC development]. And I believe that ours were also good, and we did good cooperation for that first chip. Yet, it was tough to persuade our customer, <laughs> since it's, I mean, the new architecture. So we combined the ZTAT with that RISC CPU. And then we launched that to the, like, camera applications, or digital cameras, and game machines. So of course on a game machine, it needed much more software. So we took out the, <laughs> ZTAT-- I mean, the program memory.

Fairbairn: Right.

Kihara: And we made it, [SH-1], SH-2, SH-3 or SH-4. And we did good work there. So the business itself picked up very quickly. There was a good mindset there at that time, including the top management, the engineers and the researchers and sales organizations. All those were, you know, tied closely with each other and did good. We pinned down the customers [to focus on] and we did best effort to get design-wins and to help them [use our RISC].

Fairbairn: And most of those were in consumer applications. Did you also penetrate the automotive market, or was it mainly in, like, games and?

Kihara: At the time when we introduced that, it's mainly digital consumers. But afterward, I think that, those days, the automotive customer, I mean, the engine control is using this kind of [RISC] core there. As you can imagine, that the automotive customer is very conservative.

Fairbairn: Yes.

Kihara: And it takes time for them.

Fairbairn: It took you a long time.

Kihara: Like five years or something--

Fairbairn: Yeah.

Kihara: To change these all, you know, so yeah, so.

Fairbairn: And then a long time to get into production and so forth.

Kihara: Yeah, yeah.

Fairbairn: Right.

Kihara: So at that time when we introduced this product, it's mainly all those new, emerging markets.

<laughter>

Kihara: It was very successful. We got number one position, by the way, in terms of unit shipments. Global number one <laughs> in '95, which is just a few years after the first introduction of the product. Which is amazing, isn't it? <laughs>

Fairbairn: Yeah. Very. Let's see. Were you-- So were you also involved in ASICs? In the ASIC business?

Kihara: I was not directly involved, but I did have ASICs under my management. Yes, but I'd say that I didn't do any specific--

Fairbairn: Yeah, you didn't--

Kihara: Yeah.

Fairbairn: But it was part of your organization.

Kihara: It was, ah, yeah.

Fairbairn: Did you focus your ASIC work on certain applications or certain types of customers?

Kihara: Frankly speaking, the ASIC business was not necessarily very much successful. <laughs> We did some business with the customers, but I cannot say this is one which we succeeded.

Fairbairn: Right. So it looks like Hitachi formed almost like a separate company or whatever to go after the SuperH market. You had SuperH, Inc. Was that the case?

Kihara: Yes. It's the SuperH, Inc., right? We, the company, I mean, Hitachi formed a new company named SuperH, Inc.

Fairbairn: Yes.

Kihara: Which is a joint venture with STMicro. And we licensed the SuperH to STMicro, and then we decided to [jointly develop] the SH-5, which is the highest, you know, performance among the SuperH series. And the mission of that company, SuperH, Inc., is 1) to do development [of SH5], and 2) to license these technologies to the, you know, future potential customers, including the other IDMs. But it was 2001 or something. We couldn't do the good success in doing that. The ARM was already, you know, widely used. And if you remember, <laughs> that 2001 is IT recession year the worst time to--

Fairbairn: Yes.

<laughter>

Kihara: To do it, aggressive, you know, R&Ds in general. So it's quite a bit to my regret that we couldn't do the good licensing of that SuperH. Even though we did some, you know, good business with that architecture, but we couldn't license those.

Fairbairn: Right.

Kihara: But we were IDM [Independent Device Manufacturer], so it's not-- it's not easy <laughs> to license your technology, which is the core to your business differentiation.

Fairbairn: Right. To others.

Kihara: To your competitor.

Fairbairn: Right.

<laughter>

Kihara: And likewise the, you know, customer-- I mean, the other IDM, will have some concern--

Fairbairn: Right.

Kihara: To license the technology. <laughs>

Fairbairn: Yeah.

Kihara: Which is owned by your competitor. So we did some, you know, licensing, of course. Yeah, including the STMicro or some others. But it was not good enough. it's not a matter of the strategy, I think, the business strategy. It's a matter of the business model itself. Yeah.

Fairbairn: Did you expand your architecture to 16 or 32 bit? Or did Hitachi maintain the focus on 8 bit? Or how did that--

Kihara: The SuperH is not 8 bit. 16 and 32 bit.

Fairbairn: Oh, okay.

Kihara: Yeah. And we did further expand the, you know, memory space by the SH-5 which we are talking about.

Fairbairn: Okay.

Kihara: And there are many stories there. It was something. Big, you know, R&D there. But we couldn't, you know, succeed in doing business with that SuperH-5.

Fairbairn: So, but has the SuperH continued to be an important product for Hitachi? I mean, what--

Kihara: Oh, yeah. [By the way] I was relocated from semiconductor business unit around 2000 or something or late nineties. But the SuperH itself has been, you know, core, I mean, differentiation for Hitachi semiconductor….

Fairbairn: Even today? I mean, you--

Kihara: And even today, I think that Renesas is making it. Hitachi is no longer doing semiconductor business now.

Fairbairn: Okay. All of it has been transferred to Renesas?

Kihara: All transferred. Spun off and merged.

Fairbairn: Right.

Kihara: [With] NEC and Mitsubishi. So I don't know the latest status, but as far as I know, the SuperH has been the core of Renesas' business. It's kind of a de facto standard for the, for example, car navigation systems. They did many, you know, system LSIs using that architecture, and also they did some for the cellular phones. But nowadays, the smartphone is what decides everything…and the ARM is there.

Fairbairn: Right.

Kihara: So I don't know how much they are doing there. I am sure that they have licensed ARM already with that, like Renesas. And but ZTAT technology is still there as a core technology. So I remembered that when I was doing that kind of the, you know, chip business or chip development; we did have the off-site meetings quite often with our engineers and the research group. And we were saying that let's try to make the new product which can survive, at least, and which can increase its value for more than ten years. I remember that I talked about the wine.

<laughter>

Kihara: So let's make a good wine which can--

Fairbairn: Last for a long time.

Kihara: Yeah, last and even increase its value.

Fairbairn: Yes. <laughs>

Kihara: At least get more, right.

Fairbairn: Right.

Kihara: Ten years, at least.

Fairbairn: Yeah.

Kihara: And the ZTAT is, it's '80-something, right? So it's almost 30 years old. It's more than ten years.

<laughter>

Fairbairn: Right. Very fine wine.

Kihara: Very fine wine.

<laughter>

Kihara: And SuperH is -- I mean, that this kind of the new category of the RISC machine is still, you know, a valid concept there. So most of them, I am very happy with those. I am very happy that I could do that kind of a job. I could be involved in that kind of development.

Fairbairn: So when was Renesas formed? And when did all this get spun off to--

Kihara: What, 2002, I think.

Fairbairn: Mm-hmm.

Kihara: Actually, I was relocated from the semiconductor group to the other business group. It was '90-something. '98 or something, to Telecom Division [of Hitachi]. So I did some work there.

Fairbairn: Mm-hmm. But you, it says here you were 2001, you were--

Kihara: And came back to the semiconductor group. <laughs>

Fairbairn: Oh, you came back. I see.

Kihara: <laughs> And assigned to that company [SuperH,Inc.].

Fairbairn: I see. Okay.

Kihara: Okay.

Fairbairn: So you spent some time in Telecommunications as well.

Kihara: Yeah. Opto devices [in Telecom Div.] and Hitachi did spin off that business unit, and I did some work to do that. And it was, again, it was very much, you know, interesting. And precious experience for me to spin off a business unit. It was very interesting.

<laughter>

Fairbairn: So you came back. So did you retire in 2008?

Kihara: 2010, I think.

Fairbairn: '10.

Kihara: Yeah. [Before retirement] I moved to the other Hitachi [subsidiary], ULSI Systems [in 2004] U-L-S-I meaning that - not VLSI

Fairbairn: Ultra.

Kihara: Ultra LSI. <laughs>

Fairbairn: Ultra large scale, I know.

Kihara: Ultra LSI Systems, Inc. And we--

Fairbairn: But that was after the spinout to Renesas, right? So there was still some--

Kihara: Yes. There were some, you know. Hitachi ULSI Systems Inc. is a fabless company. They did engineering work for system design and semiconductor designs, and also they did the product design as well as a [fabless] company. So we did some [fabless] chips-- chip business as a fabless company there. And also some SSD. I mean, niche market. Very highly reliable SSDs. Or, like, the software package, like a voice synthesis or voice recognition, that kind of the package software. So I was--

Fairbairn: SSD is solid-state drive?

Kihara: Yeah. Flash.

Fairbairn: Flash drive.

Kihara: Flash drives.

Fairbairn: Right.

Kihara: With special--

Fairbairn: Oh, with special architecture and--

Kihara: Yeah, yeah.

Fairbairn: Software to make it.

Kihara: So that was, that company was-- it's still there [in Hitachi]. Since, you know, Hitachi needs that kind of technology in the company, so.

Fairbairn: Oh, I see. I see, okay. So what, is there anything in particular you want to call attention to in terms of either the telecommunications or the work that you did there? Is there any specific products or things that you think were worth commenting on?

Kihara: Well, I am doing some consultation work now to one U.S.-based, technology venture company. They are specialized in the non-volatile memory. So I am interested in that, you know, technology area. Non-volatile and random access and high-speed read and write. Which means that the, you know, ultimate memory, <laughs> non-volatile, random access, high-speed, read and write. And the--

Fairbairn: Flash is normally high-speed read, but slow write.

Kihara: It's a very slow. write is slow, but, you know, very slow.

Fairbairn: Slow write, yeah.

Kihara: This is one of the hot topics in the semiconductor industry, and in the storage in specific industries for computer architectures. So I think that this kind of memory, new memory, will have a good impact very soon in storage architecture and the computer architectures.

Fairbairn: So does that require new process technology, or is that--

Kihara: It requires new process technologies, yes.

Fairbairn: Okay.

Kihara: I am also paying attention to that memory technology, so. <laughs>

Fairbairn: So new architecture, new process technology, new software all together to make a new.

Kihara: Yeah. It's interesting, yeah.

Fairbairn: Yeah. Very interesting. So is there anything that we've missed? Are there other things you'd like to call attention to or that you wanted to, maybe that I didn't ask about?

Kihara: I think that already I talked <laughs> too much, you know.

<laughter>

Kihara: I think that we covered, you know.

Fairbairn: So you've spoken about this new area that you're interested in. If you were a new student leaving university today, what--

Kihara: <laughs>

Fairbairn: You know, what technologies do you find--

Kihara: If I were a new student--

Fairbairn: Yeah.

Kihara: I mean, the student at college.

Fairbairn: What direction would you go? <laughs>

Kihara: Hmm. I would choose a career to make the-- to make or to create something which can survive more than 100 years.

<laughter>

Kihara: Or hundreds of years.

Fairbairn: Yes.

Kihara: Like, you know.

Fairbairn: You mean a memory technology or something?

Kihara: No, no, no. I think like an architect or-- <laughs>

Fairbairn: Oh.

Kihara: Like something, you know, which can last a long, long time.

<laughter>

Kihara: Not just the semiconductor and things.

<laughter>

Kihara: Ah, like-- Yeah. There are many, you know, kind of the, you know, work done there outside, I mean, in the world, so. Yeah.

Fairbairn: Okay. Well, thank you very much--

Kihara: Okay.

Fairbairn: For taking the time to share your story. And we had the opportunity to learn about some important developments during that time, so thank you very much.

Kihara: Thank you. I do-- I did enjoy talking with you. <laughs>

Fairbairn: Thank you.

END OF INTERVIEW

