Oral History of Bujirou Kobayashi

Interviewed by:
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Recorded: December 13, 2014
Osaka, Japan

CHM Reference number: X7370.2015

[Editor's note: the interviewee speaks Japanese. This interview was conducted via a translator and the interviewee's answers were transcribed to English. This contents of this interview have been edited by the interviewee.]

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Stanley T. Myers: It's a pleasure to be here. Today is the 13th of December, 2014, my name is Stan Myers, we're here to discuss with Kobayashi-san his background, and his long and prestigious career in Mitsubishi Electric. Kobayashi-san was born on September 7, 1924. He stayed in the place he was born until he graduated from Kansei Gakuin Junior High School. He entered National Ube College, currently Yamaguchi University, in 1941 to study mechanical engineering. In 1944, Kobayashi-san joined Mitsubishi Electric Corp., but at the same time he was enrolled in Japanese Navy. After World War II, he was assigned from Kobe Works of Mitsubishi Electric to be responsible for production of heavy electrical machinery. In 1957, Kobayashi-san became a supervisor of quality control in the Manufacturing Department at Kobe Works, and made his mark as an expert in quality control, quality assurance, and production management during his career until 1964. Kobayashi-san was assigned to Mitsubishi Electric Headquarters in 1964, and became responsible for developing production engineering. In 1969, he moved to the Nagano factory, manufacturing TVs under Mitsubishi's Kyoto Works, as the factory manager. He wanted to make the factory a model of production management, and he was actively involved in introducing various methods of automation to the factory. In 1975, he became the manager of the Quality Control Department at Kita-Itami Works, the administration center of Mitsubishi's semiconductor business, and he started his career as a manager in this business. In 1976, Kobayashi-san became general manager of Kita-Itami Works, and he headed a project for building a new semiconductor manufacturing plant in Saijo based on a concept of full automation, which started in 1981. The Saijo plant was constructed in 1983. It was the first fully automated semiconductor manufacturing plant in the world. He was promoted to Director of Mitsubishi Electric in 1983, Managing Director in 1985, and Senior Managing Director in 1987. During these periods of time, Kobayashi-san much devoted himself not only to Mitsubishi's semiconductor business but also to Japan's semiconductor industry.

Bujirou Kobayashi: Yes.

Myers: So this will be just like my introduction of you and I don't want to keep going because I want you to say it to the camera now. So we'll start with me basically asking the specific questions that Tani-san gave to you. We'll start from your early years, your family years, then followed with the questions on the early professional years and what were the most important. These are what you talked about before**—**the most important or semiconductor-related key projects, and I think factory automation, quality assurance **. . .** did you ever study under Dr. Deming?

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Kobayashi: No, I didn't—when Mitsubishi was awarded the Deming prize, I contributed significantly to the company as a section manager of the Production Technology Department.

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Myers: I knew him, and I studied a little bit under him when I was with Mitsubishi Material, and prior to that at Monsanto.

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Kobayashi: Was that so?

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Myers: Okay, now we'll start. Let's start with your early years, your family**—**just tell us where you were born, and what you did. You grew up and joined Mitsubishi Electric, and then we'll get into what you think were the key things to your most important achievement in your mind. Then I want your advice and direction to the future of Japan and semiconductor industries and to the young people going into college today.

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Kobayashi: I think the thing of which many people do not know is what kind of education I received at Mitsubishi. Mitsubishi treats you as a full-fledged engineer as soon as you enter the company, but several senior engineers with about three to ten years' experience give you very strict on-the-job training. I think many people don't know that I have received such training.

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Another unique career of mine is that I was a reserve officer trainee of the Naval Air Group in Japanese Navy after I graduated from the college in 1944.

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At that time, in our class of trainees there was a son of the late admiral Isoroku Yamamoto—I'm not sure if you know of him. By the way, before falling in battle in 1943, the late admiral was already well aware that Japan would be defeated and believed that it was of utmost importance how to educate young people of ability in the navy for the post-war society of Japan.

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For this reason, he sent ten or more of his best officers back to major naval bases from battle fields so that they would educate officer candidates, trainees, and others. These officers, who had the objective ordered by the late admiral, rigorously educated us and we were educated with his belief in mind.

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That was the highest education I had received at the navy. After I left the navy, I joined Mitsubishi, where I worked at the department of manufacturing heavy electrical machinery, and in particular, I was engaged in developing the production of hydroelectric generators.

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Myers: I have a quick question for you before going into another subject, and that is: why did Mitsubishi choose semiconductors as a focus? What was the reason they did that?

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Kobayashi: The answer to the question is somewhat a long story and I had been involved in it deeply.

I majored in mechanical engineering in the college and entered Mitsubishi. Large part of the Mitsubishi people were electrical engineers, so mechanical engineers were usually assigned to jobs of so-called quality and/or production control. At Kobe Works, I was primarily engaged in quality control and production control. Then I was transferred to Headquarters, where I was assigned to the Production Technology Department to give guidance to the whole company on production engineering.

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Myers: So you have felt those that were really the keys to the future of Mitsubishi Electric in semiconductors were automation, quality control, quality assurance, factory control, and especially putting those together.

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Kobayashi: Yes, and having been engaged in such tasks, I was assigned to build a new plant in Nagano separately from Kyoto Works, where we were manufacturing TV sets.

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In the 1960s, we were recruiting many young female workers of ability to assemble TV sets, so we were able to manufacture products of good qualities.

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When we faced to the situation where we were unable to recruit many of such workers in Japan, other companies built overseas factories for production in Asian countries, including China.

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However, I had conceived another idea: if we manufactured products in automation lines, we would no longer need female workers any more.

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Unfortunately, when compared with current computers, those at that time were of low performance, and it was almost impossible to use them for automated manufacturing plants.

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I was pondering what we had to do in order to use computers for this purpose. At that time, however, the degree of integration of semiconductor products, or that of ICs, were low and we were not able to use them for computers for factory automation.

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For the above purpose, the low performance of computers was the critical problem we needed to solve, and solving it was a serious challenge.

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The semiconductor memory plants of Mitsubishi were mainly developing devices of 4K and 16K bits in capacity. However, the plant managers hesitated in developing those of larger capacities because there were severe shortages of resources available for the development.

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We stayed in such a company situation for a while. In the meantime, the Ministry of International Trade and Industry determined to bring forth a government policy of accelerating development of advanced semiconductor devices to improve computer performance. This became a large issue for us.

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Myers: I remember, MITI now METI, same group though.

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Kobayashi: MITI required five electrical manufacturers to develop semiconductor devices, memories in particular. The five companies were, as you know, Hitachi, Toshiba, NEC, Fujitsu, and us. Though Mitsubishi had this requirement, our plant managers were still hesitant to join such a project for the above-mentioned reason.

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Kobayashi: At that time, the president of Mitsubishi, Sadakazu Shindo, became aware of the situation. His response was “That is not good.” He was much interested in manufacturing semiconductor devices that could improve computers’ performance. President Shindo ordered me to move to Kita-Itami Works and to examine whether we were able to fulfill MITI’s requirement, because I was interested in production of semiconductor devices.

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That is the reason why I was appointed as manager of the Quality Control Department at Kita-Itami Works. The manager of quality control was able to supervise all plants, so I planned to check to see that Kita-Itami Works would be able to establish a system for fulfilling MITI's requirement.

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I was transferred to Kita-Itami Works and actually conducted an investigation to see whether Mitsubishi was capable of carrying out such a project. I concluded we indeed had the capability and reported to President Shindo that we should go ahead.

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Soon he appointed me as general manager of Kita-Itami Works and ordered me to develop high-performance semiconductor devices along with the other companies, five in total.

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As a result, we started engaging in developing semiconductor devices, but we needed many engineers and much money for the project.

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So I asked the related departments in our company for the personnel and capital needed and President Shindo fully backed me up.

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We proceeded to develop 64K- and 256K-bit memories. However, they were difficult to make without a new manufacturing factory and upgraded equipment for production.

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So, developing upgraded semiconductor manufacturing equipment became a serious challenge. However, Japanese equipment manufacturers were so much cooperative as to give us their full support.

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On the contrary, US equipment manufacturers would not respond to our challenge willingly. I think this was a large difference between Japan and the US.

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We had been able to use good equipment, but we had another issue in semiconductor production. It was the issue in production yield. If yield is low, the sales prices of products become high and are not acceptable to our customers.

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To reduce production cost, we needed to downsize the chips of semiconductor devices. So we kept making chip patterns finer and finer.

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At the same time, we were clearly aware that the finer made are chip patterns, the more affected is production yield by the dust in the plant.

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So it was required first to build a new plant and second to ensure it a significantly higher degree of cleanliness.

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To improve the quality of clean rooms, we needed to minimize the dust emitted from workers. They were the main source of dust.

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So reducing the number of human workers became the large issue on yield as well as labor cost.

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On these conditions, we started constructing a new plant. However, Japanese equipment manufacturers were not able to supply the equipment that met our requirement for automation.

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So Mitsubishi and equipment manufacturers collaborated to build the new plant.

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Every semiconductor company was in a similar situation, and Mitsubishi demanded full automation most aggressively among the five companies.

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The Saijo plant was constructed on the above ideas, and we started the project there.

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The feature of the Saijo plant is that it was built on the idea of full automation.

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The fully automated Saijo plant was later filmed by the camera of NHK, a representative broadcasting company in Japan, in detail—even the inside of the plant—and the shots were broadcasted to the general.

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However, the plant had been kept as a corporate secret since its construction.

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At that time, a US investigation team came to Japan to find the reasons of high productivity in Japan.

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At first, I refused them to visit the Saijo plant, but the Ministry of Foreign Affairs asked us insistently to accept them.

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In addition to the above situation, since the equipment manufacturers knew the details of our plant, we decided to disclose it to the US team, and later, through equipment manufacturers, to semiconductor manufacturers in Japan and also in Korea.

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Myers: Just a quick question: was this in the beginning or middle of the 80s into the 90s because there was a period of time Japan's semiconductor business gained superiority in the world, and I was wondering if this came as a result of that group, or did the group get set up during that period of time?

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Kobayashi: I think the following can be the answer to it:

There were five major semiconductor manufacturers in Japan, and the competition among them was very keen already before we constructed the Saijo plant. After its completion, the Saijo plant became a new target for other companies, and each of the five companies made efforts to manufacture products of better qualities in lower costs.

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In addition to the five companies, SONY and Panasonic, which had each a large in-house market for consumer-electronics products, aggressively expanded their semiconductor business and encouraged the cutthroat competition further.

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I think the reason why Japanese semiconductor companies grew strong was the vigorous competition among them, which drove them to become superior to US companies. We observed that US companies hadn't encountered such tough competition in the domestic market. Was that true?

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Myers: Well, I think it may well be competition there, but maybe it's done in a different way. I'm sure within like SEMATECH, there were fiercely competitive people—TI and so forth, but I think they maybe weren't driven as strongly during that period as the Japanese were driven to succeed. I think there may have been a period of time that they didn't feel fierce competition amongst themselves, but certainly these people, Intel and IBM, finally decided that they had to work together and compete at the same time. But during that period of time, I think the Japanese were more competitive—not only with themselves, but with the world, which usually makes business grow when that happens. [After translator talks with Kobayashi] I was going to say that I think SEMATECH became more competitive when the government got out of it, and the companies that had run SEMATECH had to compete with themselves and still be successful at SEMATECH. At the beginning, the US government was involved—I think SEMATECH maybe wasn't as successful at that time as it was when the companies were running it. Personal opinion.

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Kobayashi: I think one of the reasons that we have lost competitive strength is our corporate collaboration in a memory field. We collaborated with ourselves in producing memories by establishing a corporate organization. What was the name of company? Elpida? As a result, all of the Japanese semiconductor manufacturers lost their competitive strength, and now Korean semiconductor manufacturers are much stronger than us.

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Myers: I think they came later. In the 1980s, Japan became very strong, and then 90s, about even, then after 2000, I think things like he just said made Japan more weak maybe. I'm focusing back on the late 80s—that's when Japan got very, very strong in the semiconductor area. That makes sense? And I also believe in the case of DRAMs, there were too many companies for the size of the market.

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Kobayashi: Indeed, it is true that there were too many companies, but because of the competition, we advanced ourselves to develop DRAM of 256K, 1M, 4M, and so on. It was the competition that drove

developmental motivation, and I think I can say that, after this period of time, we became less competitive.

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Myers: It changed after that, but yeah.

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Kobayashi: Allow me to explain to you a little further about the Saijo plant.

I think the major difference between the fully automated Saijo plant and others was in the degree of cleanliness. When the Saijo plant was built, the degree of cleanliness we had achieved there was far higher than its level usually expected at that time. We filtered out dust from in-taking air completely, and clean air was sent to the middle floor of the three-story building, where we had production spaces. The top floor was the place for taking air in and the bottom floor was the place where air was absorbed for exhaustion.

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In the top floor there were many air-conditioning apparatus for cleaning the air taken into from the outside, the middle floor was used for production, and in the bottom floor there were set up power-supply units and others that might produce dust.

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Myers: Utilities?

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Kobayashi: Yes, and workers were admitted into the bottom floor only.

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Myers: No people?

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Kobayashi: Do you have any other questions? At the factory, silicon wafers were input without human labor, and then ICs were output. It was such a factory that required no human labor.

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Myers: The human, right.

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Kobayashi: That was why the yield at the Saijo plant was 95%.

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Anyhow, the cost of memory chips can be reduced if production yield is high. This is the reason why Japanese products were inexpensive and of good quality.

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Please ask me something else like, “What’s the mechanism of something?” Not only about the Saijo plant.

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Myers: Okay, and basically what advice you have for technical students entering to the university today. We got young students – we have all kinds of technical users, typing and pressing the buttons, but do you advise them to get into understanding the fundamental technologies in the semiconductor area, and if so, how do they go about it?

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Kobayashi: I’ve already retired, and now I’m not involved in production at factories. I’m afraid I’m unable to give them any advice. I haven’t thought about it.

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Myers: I understand that.

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Myers: Yeah, and I think that pretty much covers my questions. It’s interesting in the US, the tendency for young people. My grandchildren and my children were to go into the more liberal arts than the hard engineering, and I think that’s changing a little bit. All of my family said “we don’t want to work as hard as you did. We’re going into being a lawyer or some dumb thing like that.” And I think that is going to be a possibility of limiting the raw engineering resources, not only in the US, but in all countries. I think the young children are off doing wanting to do other things than the hard work of engineering.

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Kobayashi: Japan is in the same situation. It’s a serious issue that college graduates who majored in science and technology are hardly promoted to the corporate management level. I think they consider it a critical issue.

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Myers: That's a problem, yeah. You know, before I left SEMI, I set up a foundation to teach young children that math, science, technology, and engineering can be fun. Don't be afraid of it, it can be fun. And we begin to try at a small scale to convert some people that say "I never enjoyed math, I never enjoyed the technologies, but now I am." And many of these now children that we started this in 2002, that have gone through our program are beginning to choose more technical courses than they would have done before. And we're studying these kids over time to see when… [To translator] I don't know if you were involved in any of SEMI's high tech…you know what I'm talking about, so maybe you can explain it in Japanese better, [back to Kobayashi] but it was a belief on my part that we should push that program and that's why we set up the foundation. We got a little bit of money now to support it, and I think we're into the thousands of kids.

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Kobayashi: Just a minute.

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Myers: Oh yes, Lisa Anderson heads up the Foundation, and we've done four or five in Japan now, and about seven of them in Europe, and a couple in Singapore, so it's not just in the US; and in the US many of them, but I think there has been literally thousands of students that have gone into the program, and we've had a successful rate of changing their mind from dropping out of school or becoming a lawyer to becoming involved in technology. So we think we're having success with it. I hope you're not recording this – I mean this is for his interview, not me talking.

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Kobayashi: Are we recording that?

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I've already retired from the field and don't almost get involved in that kind of issue. I'm afraid I don't know about it.

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However, I know what you mentioned is becoming a large issue in Japan.

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Myers: It's amazing, you know, today that we all, not just young people, we all don't have to learn how to do some fundamental mathematics and this kind of thing. I can just pick up my iPhone—you want the square root of 150? Well here's your answer. The computer does it for you.

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Kobayashi: That's right. But I think good groups . . . many research groups in Japan—for example, the one received the Nobel Prize—are doing well with regard to that.

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Myers: Right, I saw that, it was very good. You know, a couple of examples of my own family. One time, I have a swimming pool, and we were sitting there, I had a granddaughter, granddaughter, and a grandson, and I'm sitting in the middle, and nobody is saying anything. And I said, "Why don't you guys talk to each other?" And they said, "Oh, we are." And they're sitting there right beside each other. It's crazy. I have one other family example. We were sitting at a big dinner table, and my family when we all get together is 14 people, and all of a sudden I had a big question. Everyone's sitting and eating, doing the normal thing, and I said, "I wonder what this is?" The first thing that they thought of was to pull their iPhone out and ask Google. They wanted to be the first to give the answer. [After translator asks for clarification] No I asked the question—oh it was a sports question. Now I remember: I asked who won the football game? And they all pulled their phone out to give me the answer. In the old days, we would've discussed it. But that's what our technology has done, to this level. Now what's next, if you think about our time frame, we didn't dream of iPhones or smartphones**—**we didn't dream of certain things we do on the computer. We didn't dream of the Internet, and that was like the late 80s or early 90s, and look at the changes we've had to where we are now. What do you think it will be after 10 to 15 years from now? And we'll sit back and say, "How stupid were we? We didn't remember, or didn't know how to guess?" So I think we humans are blessed with very poor vision of what the future is.

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Kobayashi: I agree with what you are saying.

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Myers: Well if you were to ask me in 1989 or 1990, "What would be available in the future 10 or 15 years," I would've never guessed the Internet of the things we were doing with smartphones, any of this that we're doing today second hand**—**I would have never predicted it. Maybe in the funny papers **. . . .**

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Kobayashi: Yes, indeed.

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Myers: Okay, [to translator] I think we are. How're you feeling Eric? Everything okay? Sounds good.

END OF INTERVIEW

