Oral History of Shigeyuki Ochi

Interviewed by:
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Fairbairn: Welcome. We are at the New Otani Hotel in Tokyo Japan. It is June 23, 2016. I'm Doug Fairbairn and I'm speaking with Shigeyuki Ochi, yes? *(Ochi: Yes)* Ochi-san has a very extensive background in imaging technology and CCDs. And has made many important technologies in those field, in that field. So, welcome and thank you for joining us. We will spend most of our time discussing your technical work and technical contributions, but I would like to get a little bit of background in your personal life. So, can you tell me when and where you were born and a little bit of your early family life and where you went to school initially.

Ochi: I was born in Dalian, Manchuria.

Fairbairn: That is now part of China, yes? *(Ochi: Yes)*

Fairbairn: And you were born in 1938? *(Ochi: Yes)*

Ochi: My father was a doctor of internal medicine and worked for a company as a doctor.

Fairbairn: Did you go to early school in Manchuria or did you move back in to Japan?

Ochi: I came back to Japan just before I was one year old birthday.

Ochi: I moved to Imabari City of Ehime Prefecture and went to an elementary school there.

Ochi: Since it was just after the World War ended, I had to move six times during elementary school time. It was a chaos period of Japan right after the war.

Fairbairn: So you mentioned in your summary here about a famous architect, (Kenzo-san). Did you meet him at your school?

Ochi: No, I have not met him.

Fairbairn: But one of your teachers said you were very good in mathematics and that encouraged you to pursue that area *(Ochi: Yes)*. Did you enjoy mathematics?

Ochi: Yes, I like it.

Fairbairn: Were there any other subjects of particular interest or did you play sports or any other activities when you were in school?

Ochi: No, not any special one in the sport area.

Ochi: I was interested in the job where the mathematics can be used, like communications.

Fairbairn: You went to university at Tokyo Institute of Technology. Can you tell me why you selected that school and what area you studied?

Ochi: The reason why I chose Tokyo Institute of Technology was they have very excellent qualified professors there in communication field. That's why I selected it.

Fairbairn: Who were the people that you found most influential at the university?

Ochi: Professor Yasuharu Suematsu was my teacher.

Ochi: At that time, he was not a professor yet, sort of an assistant to professor.

Fairbairn: He was the what? *(Translator: Assistant)* Assistant. (*Translator: Assistant to the professor.)* What degree did you earn at the university, at Tokyo Institute of Technology?

Ochi: Doctor in engineering.

Fairbairn: Do you remember…page 8… Do you remember when you entered the university and when you graduated?

Ochi: I need to recall my memory…..1962, I graduated Tokyo Institute of Technology.

Fairbairn: So you graduated in 1962 with PhD *(Ochi: No)* or Doctor…

Ochi: No, Bachelor.

Fairbairn: And was the bachelors in mathematics or communications? What was your specialty?

Ochi: Electronics engineering.

Fairbairn: So did you go to work at Sony right after you graduated in 1962? *(Ochi: Yes)* How did you, why did you choose Sony?

Ochi: My thesis is the application of microwave by Esaki Diode.

Ochi: My teacher told me to go to Sony to get the Esaki Diode. I bought it at 3,000 yen per piece.

Fairbairn: And the Esaki diode was useful for microwave communication? *(Ochi: No)* No? What was its application?

Ochi: For computer, mainly.

Ochi: A lot of Esaki diodes were used in computer.

Ochi: On the other hand, microwaves were used only three.

Fairbairn: What was your first job at Sony? What kind of product were you, or were you in a research laboratory?

Ochi: I was assigned not to a laboratory, but to technology department of headquarters.

Ochi: My first assignment was, let's see, to develop a new microphone, MOS transistor.

Fairbairn: MOS transistor. So MOS was very very new at the time.

Ochi: Sony invented transistor radio as the second place in the world.

Ochi: Because of the technology, Sony was able to be the top player of bipolar transistor and radio in the world afterward.

Ochi: However, Dr. Ibuka and Dr. Iwama who were core members of the technology development moved to ther department.

Ochi: At that time, Casio commercialized electric calculator with MOS in the market. It drastically changed the world.

Ochi: However, the top management of Sony did not understand the change of the world and stick to the bipolar transistors.

Ochi: This made Sony behind the competitors.

Fairbairn: So, you worked on the development of MOS transistors at Sony?

Ochi: Yes, however, it was not well supported. I would say, great resistance to the development of MOS transistors.

Fairbairn: Who made the decision for you to do MOS, and what application did you have in mind?

Ochi: Good, but, hard question. I can not think of any individual leadership. Sony grew very quickly and there are no specific individual person who led the business success.

Ochi: This made you do whatever you want.

Fairbairn: Why did you think it was important? What application did you have in mind?

Ochi: When I read the technical paper on MOS by RCA, I believed quickly that this is the technology for the future.

Fairbairn: Not many people realized how important CMOS would become, so you were very early.

Ochi: Maybe, you were right partially. However, in terms of the business it didn't turn out well.

Fairbairn: You did not have any background in semiconductor devices before joining Sony. Is that correct? You more studied in mathematics and communications. Developing MOS devices seems quite different.

Ochi: Yes, however, because I used Esaki diode, so I had knowledge of semiconductor device.

Fairbairn: You later on took responsibility in CCDs. How did you, when did you first start work on CCDs and why did you make that change?

Ochi: CCD was originally invented at Bell Laboratories. The inventors said that it is not a very simple device.

Ochi: There was a big gap between research and commercial market. Then, US get the fund from its Air Force, no, Navy, Naval Research Laboratory, into the commercialization of CCD.

Ochi: However, there was an issue about security. Some very important technologies that should be disclosed in Naval Research was disclosed at one of the conferences, academic conference.

Ochi: That was the end of honeymoon period between Naval Research and academic society of CCD.

Ochi: Even after that, Texas Instrument and MIT continued the research for the application for astronomical observatory, satellites, etc.

Ochi: Well, due to the limited budget for the CCD development, the development did not go well for TI or MIT in the US.

Ochi: There was very little interests among European companies.

Ochi: Whereas the Japanese manufactures in video, semiconductor, and consumer electronics, they think that there is a future in CCD. So they started and continued development for CCD technology.

Fairbairn: When did you first start, when did you first become aware of CCD and when did you start development in that area?

Ochi: Well, 19…. 1970.

Fairbairn: You started work in CCD in 1970? And so you started work at Sony in 1972, err '62. And you started work in CCD in 1970. So, did you, when you first started at Sony you were working on helping develop MOS devices. Did you continue that work through until 1970?

Ochi: Yes, as for my career I was engaged in development of MOS from the beginning, from '62 through 1970, and I moved to CCD. But CCD technology was significantly difficult than MOS.
Therefore we performed badly.

Ochi: It is the same situation for other Japanese manufactures. So many of the companies withdrew from the market.

Fairbairn: They did not pursue CCD. So, why did you continue to pursue CCD? Because you thought it was important, or did management think it was important? Who made the decision to continue to pursue it?

Ochi: As shown in the title of the book, it says "challenged by engineers, challenged by scientists." So the engineers at Sony wanted to pursue their challenging dream, CCD.

Fairbairn: And was Sony making video cameras at that time? And did they want to pursue CCDs to put into video cameras?

Ochi: Video camera…. It was the age of camera tube using CRT.

Ochi: But, mostly Sony bought camera from Thompson (France) and Toshiba at that time.

Fairbairn: They bought the business or they bought the technology, what?

Ochi: Camera itself from Thomson or Toshiba.

Interviewer: And you wanted to - did you think you can make your own camera with CCD?

Ochi: I should say, CCD has an interesting feature. When you look at a semiconductor, it looks just a stone with black material because it is covered by ceramic package. It does not attract people at all at the exhibition. However, CCD draws peoples' eyes. It shows images.

Ochi: So I would say that why they pursued CCD development mostly comes from the interest or enthusiasm by the engineers.

Fairbairn: So you thought you could make it into a workable camera.

Ochi: Yes, and we were enganged in the development of camera at the same time. Camera and CCD image at the same time in the same team.

Fairbairn: And how long did it take, did you have the support of management to do this work? Or were you mainly doing it the back room or on the side?

Ochi: Well, at that time Sony management people did not have a clear view about CCD. So they don't know much about CCD and they're not sure about the future of CCD. And there was no actual leader in development team. No one has an experience in CCD.

Fairbairn: So, you just proceeded on your own to do your own research.

Ochi: Yes. Well, I just believed. I would say, it was fun.

Fairbairn: So, how long did it take before you had a CCD that was good enough that you can see that you could make a camera from it?

Ochi: It was from 1970 till 1985. 15 years in total?

Translator: Fifteen years, the first camera was made in 1985 using CCD.

Ochi: yes, the first alpha type or beta type was made in 1980.

Ochi: Although it didn't meet the business aspect.

Fairbairn: How the camera that you had in 1980, how many, what was the resolution? How many elements?

Ochi: Well, resolution 240.

Fairbairn: And in 1985 you had something that was good enough for a commercial product?

Ochi: Yes. The product made in 1980 used two chips. Two chips of 240 resolution means 120 resolution per chip. Then, it improved to 240 resolution by one chip in 1985.

Fairbairn: In 1985 did that become a commercial product? Something that Sony sold?

Ochi: Yes.

Fairbairn: So, it took fifteen years when you started development to when you had a commercial product. *(Ochi: Yes)* Sony was very dedicated to, or you were very dedicated. Was there, were you aware of other companies continuing to do development in this area?

Ochi: When Sony put the product in to the commercial market, there were other companies doing the business, however, Sony had 90% share of the total market.

Fairbairn: I see. And was the first application for a movie camera, TV camera? And when was that technology applied for still photographs or still camera?

Ochi: Yes, the first application was movie camera, and when you look at the market share the camera market was 3% if you compare with the recorded market, recording market.

Ochi: President Iwama, then, assigned us to develop camcorder which is a mix of the camera and recorder. This means that the Sony would have 100% of camera share for camcorder.

Fairbairn: When was that? When did they request you to develop both?

Ochi: I do not remember when. Anyway the pie of the camera market itself grew very fast quickly.

Fairbairn: The market for the recorder became very big because the camera was… So when did you announce, when did Sony announce the first camcorder?

Ochi: The first generation camcorder did not use CCD. Camera tule and VTR were used for the commercial product.

Ochi: The sales was poor.

Ochi: It was before the camcorder with CCD.

Fairbairn: So when did, when did you first develop the first CCD based camcorder?

Ochi: The first products were in the market in 1985. Therefore, the product itself was made about a year before.

Fairbairn: That was the first camera; that was first camcorder? *(Ochi: First camcorder)*

Ochi: If you means camera, still camera, Sony had been in the business before 1985. Very few success in sales.

Ochi: At that time a photographer carried still camera and other person carries VTR for recording on his back.

Fairbairn: So it's not really a still camera, it's a video camera without the recorder.

Ochi: Correct. No wonder we were not able to make fortune from those products. It required two person, photographer and other with recorder followed after.

Fairbairn: I'm confused because a recorder is for recording video, so the camera must be a video camera.

Ochi: I would say yes video camera, but you can use as a still camera.

Fairbairn: So when did Sony make a video camera integrated with the recorder so you had camcorder together with the camera. When did that first?

Ochi: Just before CCD, Sony had camcorder together with camera tube. However, the sales was terrible. Well that is business.

Fairbairn: What was the, so after 1985 you continued to work on CCD. Was that to increase the resolution, increase the quality, both? Were there specific issues or problems that you remember that you worked on to improve them?

Ochi: : I would say, industry standards issue. For example, NTSC - industry standards sometimes helped the products to expand the market of the products. However, at the same time, it can stop the technologies or functions. For example, NTSC helped the expansion of the camera market, but same time it doesn't require the camera with certain level, above, above the certain level of resolution. So, it kind of stopped the development of the technology.

Fairbairn: I see. So, did… Did the development work slow down because of the standards and when HDTV became standard did that then accelerate development again?

Ochi: Yes, correct. However, again HDTV brought a barrier for technology development later.

Fairbairn: So, it slowed down again. So, when, what years did you work on the development of HDTV CCD?

Ochi: HDTV… It was around 1990.

Fairbairn: In your description here it says you won a science based Emmy Award in 1990 from the National Academy of Television Arts & Sciences. Was that an exciting award for you to win? Did you know, were your surprised?

Ochi: Not really. The Emmy Ward which I won was for the entire CCD imaging technologies achievement. Therefore, many people expect that before it was announced. Actually award selection includes sort of political decision made.

Ochi: When we first received the announcement of the award winning. We thought that Sony was the only one company who won the award, but when we went to the ceremony we found that there were several other companies from Japan received that same awards. So I thought that it's sort of political treatment made.

Fairbairn: So you also received several other awards including the Sony Ibuka Award and the Whole Country Invention Award in Japan. Were those more exciting to receive?

Ochi: So, so. *(Fairbairn: So, so?)*

00:51:53:23 – 00:52:19:25
Fairbairn: Did you say earlier that you retired in 2006, is that right, ten years ago. Did you continue to work on CCDs for cameras throughout your whole career from 1970 to 2006?

Ochi: I became corporate research fellow of Sony in 1999 and became responsible for other fields than CCD at Sony's technology development.

Fairbairn: What is the development or achievement you are most proud of? Is there some specific part of the work that you think was most interesting or challenging?

Ochi: I would definitely say the commercialization of imaging sensor technology

Ochi: Others, I wouldn't say that they're significant.

Fairbairn: So, you mentioned here that management did not support your initial work that is what was mainly driven by the engineers who felt that CCDs could be made into an important product. Was it not until 1980 or 1985 that the management understood the importance of the work?

Ochi: At the early stage where our team didn't have enough human resource or budget, the headquarters did not pay attention to the research that we did. However, the headquarters let us do whatever we want and did not touch into detail. Then, more we spent or invest money or more people engaged, the headquarters tended to pay attention and they want to be involved in. But president Ohga was very supportive and he had very deep understandings in terms of the technology development as well as for the lawsuit by Fairchild. I appreciate very much for his great support.

Fairbairn: And so he, what was the president's name? Ohga? and he was, he had a technical background he was?

Ochi: Ohga is musician. (*Fairbiarn: A musician?*)

Ochi: Mr. Oga graduated from the music university in Berlin, in Germany. So he doesn't have technical background, engineering background.

Fairbairn: So, you started out saying early on in university you were very interested in mathematics, you were very good in mathematics. But did you get to apply that interest in mathematics through all your work in CCD or was that a totally different skill set that you developed?

Ochi: Only communication field, after mathematics. Others are just on the line of extension of math.

Fairbairn: But the communication, the CCD development did not involve communication.

Ochi: Correct. Therefore, I moved from communication to semiconductor.

Fairbairn: Were you.. Did you feel you were competing against some other group to develop the CCD camera, other companies? Or were you, was Sony the only major company pursing that technology at that time?

Ochi: There were some other companies who tried to expand the market. However, in terms of the technology level and business scale, Sony was almost dominating, dominant market.

Fairbairn: Once Sony announced the CCD camera, did other companies then start to do development in that area?

Ochi: Yes. They tried.

Fairbairn: Which other Japanese companies?

Ochi: Japan Victor Cooperation, JVC.

Fairbairn: JVC. What about Canon?

Ochi: They tried, but, they did not go well. They failed.

Fairbairn: We had a discussion before we started the video tape about a lawsuit that Fairchild brought against Sony. Fairchild claimed that Sony was violating their early CCD patents, is that correct?

Ochi: Yes, both early patent and Amelio patent both base.

Fairbairn: Early and what? *(Translator: Amelio patent)* Amelio, Amelio (Gil Amelio). Were you able to demonstrate that you had not used their technology that you had developed your own independently?

Ochi: Actually, the final case of this lawsuit was turned out that the patent was not originally from Fairchild. Some other company had patent before. Therefore so it wasn't really developed by Sony itself, but it wasn't Fairchild either.

Fairbairn: I see.

Ochi: I forgot the name of the company.

Ochi: Ah, Hughes Aircraft! The technology was developed by Huges Aircraft before Fairchild.

Fairbairn: And so, looking to the future what are the important imaging technologies, as we look to the future? Will we continue to use CCD? Is there other new technologies that have come along or that are in research now that you think will become important? What is the status of CCD technology today for imaging?

Ochi: I would say that 20th century is physics based century and CCD is based on physics currently. It is silicon device.

Ochi: However, I expect that there will be a shift to organic chemistry and biology oriented.

Fairbairn: Is Sony doing research in these very advanced new areas?

Ochi: I believe that most of the companies who deal with CCD is doing research, they have a patent. However, there are I would say two companies who are disclosed their research in very advanced new areas at conference, that's Fuji Films and Panasonic. They are conducting the research in organic chemistry, not so much mentioned in biology.

Fairbairn: Do you think we have covered the important topics in our discussion? Is there anything else you would like to add before we wrap up our todays discussion?

Ochi: There is unknown area in chemistry. Reliablity. *(Fairbairn: Reliability?)* Yes.

Ochi: The human beings can live for 80 or 90 years.

Ochi: I think that biology can cover the areas which chemistry can not manage.

Fairbairn: So, when you say biological, you mean the functioning in the same way our eye works?

Ochi: When I said that reliability in chemical field is not stable that means that product, the life of the product. But human beings currently everybody can live till about 80 years or so. Probably biological aspects can cover the life of the products.

Fairbairn: Okay, thank you very much. *(Ochi: Thank you)* We appreciate you sharing your background and knowledge with us it's very important, thank you.

Ochi: Thank you very much.

END OF INTERVIEW

