

Episode 3

Learning from the US

I joined Hitachi and started working on semiconductors in 1959. Technical gaps between Japan and the United States in these times were so big, as can be compared to the difference of sumo wrestlers between Yoko-zuna (the highest rank) and Ju-ryo (6th rank below Yoko-zuna) in traditional national sports of Japan. It was like that Ju-ryo, Japan, repeated training by the help of Yoko-zuna, the US.

When transistors were developed in the United States, Japan was under the occupation by US, and technical literatures from US could not be obtained freely. Shoji Tanaka, the late Professor Emeritus of the University of Tokyo, one of the pioneers of semiconductors in our country, recalled these times as follows.

“I could hardly purchase foreign academic journals, and I do not remember seeing a newly published “Physical Review Journal” at that time. Probably they were not in the library of the University of Tokyo. There was a branch office of the US Embassy in Toranomon, and foreign academic journals were available there to some extent. So, I went there when necessary and copied them by handwriting on the notebook.” (cited from Journal of the Institute of Electronics, Information and Communication Engineers, August 2006 issue).

In the Japanese electronics industry, transistors were regarded as a major business target in the first half of the 1950's, and each company would sign technology introduction contracts with leading manufacturers in the United States. Toshiba and Hitachi signed technical agreements with RCA, and Sony signed a patent agreement with Western Electric.

In such a background, there were three major patterns in which Japan learned from the United States as described below. One was dispatching engineers based on technical contracts, the second was participation in academic conferences, and the third was studying abroad at the US universities. Technology transfer from the US to Japan advanced through each case.

Case of engineer dispatch

After a technology contract was signed, each company in Japan tried to acquire technologies by sending top-notch talent to partner companies.

For example, at Sony, Kazuo Iwama, who was responsible for transistor development, made a long business trip to Western Electric, conducted detailed technical investigations, and created careful reports. They are called “Iwama Report” inside the company, and are kept safe even today.

The leader of the technology transfer at Hitachi semiconductors was Seikichi Miyagi, then the General Manager of Musashi Factory. Minoru Ohno, a senior process engineer in Hitachi, introduced in his interview in “Autobiography of Electronics Nation Japan” about Miyagi's report on his long business trip to RCA as follows.

“Miyagi-san was very good at sketching and carefully gathered the sketches of each step of the semiconductor manufacturing, including the material and the parts, and even the movement of the workers very carefully in the report to make it easier for readers to understand.” Each report

consisted of about 30 pages of A4 size, and all the 15 reports are still kept. Such a reporting style became an example for Hitachi's business travelers after that.

In this type of dispatch of engineers, the length of stay ranged from several months to as long as one year, and thus played a major role in technology transfer from the United States to Japan.

Case of participation in academic conferences

International conferences related to semiconductors are held in many places in the world today, but the leading role in the early days was played by the United States, and two major conferences were started in the 1950's.

ISSCC (International Solid-State Circuit Conference), which is also generally said to be the "Olympic Games of the semiconductor", has developed into a technical forum with thousands of participants for presenting new semiconductor circuits and products. The first meeting was held in 1954. Although it was named "International", there were only one participant from Japan and one from Canada outside the United States in this first meeting.

Also at the same time, the IEDM (International Electron Devices Meeting) centering on semiconductor device and process technologies was established, and it has become one of the two major conferences in semiconductor along with the ISSCC.

For semiconductor engineers in Japan, information at academic meetings was extremely valuable, and many engineers participated in these meetings. Participants from Japan were enthusiastic about trying to get as much information as possible, taking front venues as close to podium as possible, often holding cameras. Every time a good slide came out, many shutter sounds echoed in the dark room. Such strange scenes incurred many participants' displeasure and came to be regulated. I feel bashful in my mind that I also was a part of it when I was still a fledging engineer.

The first semiconductor conference I participated in was ISSCC in 1966 when I was studying in the United States. At that time, much of research and development was done on the east coast of the United States, and ISSCC was held at the University of Pennsylvania on the east coast. As the time goes by, the conference location moved to San Francisco on the west coast reflecting the shift of center of gravity of the semiconductor R&D activities.

When I first attended this conference, I received a great shock. I heard the word "LSI (Large Scale Integrated Circuit)" for the first time. It is no exaggeration to say that the greatest harvest during my study abroad was encountering with LSI. In the report after returning home, the point I emphasized most was "We should work on LSI development as soon as possible in Hitachi."

Case of study abroad

In the 1960's, Hitachi and other companies in Japan established an internal system to encourage employees in order to study abroad by subsidizing the cost associated with it. I was also one of those who studied in the United States through the system, and I would like to introduce the case through my own experience. Five years after I joined Hitachi, I applied for studying in the US with the superior's recommendation, and I studied at Stanford University for one year from 1965 to 66.

The pioneers of semiconductor technology such as John Linville, John Moll, Bob Pritchard, Gerald Pearson etc. were among the professors, shining like bright stars. And the transistor inventor William Shockley also had his office at Stanford.

The Department of Electrical Engineering at Stanford University, with John Linville as the department chairman, shifted the curriculum from the vacuum tube to semiconductor, in probably the earliest timing in the US. Stanford was playing, in a sense, a role of the brains of Silicon Valley. I personally got valuable advices from John Linville on various matters, and he was the great mentor for me.

In retrospect, there are unexpected “encounters” at important milestones in life, and the encounter with John at Stanford was one of those for me. It was extremely valuable, and he was the benefactor for me in my semiconductor life.

Following are some strong impressions of my study abroad, which still vividly remain in my memory.

- First of all, it is a spacious and wonderful campus environment. Because of too much space, bicycles are a necessity to move from one classroom to another. There is also a fine golf course adjacent to the campus, and great golfers such as Tom Watson and Tiger Woods nested from here as global players.
- Professors are good at teaching with extremely kind attentiveness, and students ask questions eagerly until they are satisfied. Some teachers give homework which they score, and tests are done in the middle and at the end of the quarter. There is also a system in which students evaluate teachers at the end of the term. All of these were a surprise for me since the situation in Japan was quite different, or rather opposite.
- Computer programing are prerequisite for all students. A Burroughs main frame computer was installed at the Stanford computer center. Students received “ALGOL” language lessons, and in the final test they had to actually solve the given exam questions like maze problem by computer. I strongly felt that it was the major driving force to promote computerization in the United States.
- International students’ acceptance systems are very well organized, and many people return to their home country with the impression that “It was good to have learned in the US”. Homestay systems, traveling to Yosemite Valley in a group of international students, New Year's party in Los Angeles, “Japan Day” event, etc. are still unforgettable memories.
- Fierce hidden competition among students. It was in the midst of the Vietnam War at that time, and the possibility of being drafted increased if the grades were bad. An American student came to ask me one day, “I want you to lend me a notebook because I was unable to attend the class yesterday.” I hesitated and said, “My notebook is quite incomplete as I cannot understand the lecture in English completely. Your friend Jack was also in the class, so why not ask him instead?” He said, “Because American students compete with each other, it is hard to borrow

from him". So, I decided to lend my notebook; a little embarrassing, but with the compassion of Japanese samurai. I felt a subtle shadow casted by the Vietnam War.

- Industry-University collaboration with Silicon Valley companies.

Universities play leading roles in research and development while supplying competent human resources. Companies participate in joint research programs with universities, and they not only support universities financially but also dispatch lecturers to them. The role Stanford played in the development of Silicon Valley is quite large.

The time machine flies for a quarter century from this time, and it is spring of 1990. I invited Prof. and Mrs. Linville who were benefactors in my semiconductor life to a Japanese restaurant in San Jose, California. He had already stepped-down from the front line, but he was still very energetic, and we had lively talks on many subjects including memories at the time of Stanford. (See photo below). I met him several times when the opportunities arrived afterwards, and shared the nice, enjoyable times.

Memories of Stanford are still living fresh and shining in my mind even now.



Photo 3.1 Prof. and Mrs. John Linville, my mentor during my stay at Stanford (April 1990)

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