

Episode 5

Opening of the LSI Era

-- Amazing Personnel Placement at Hitachi --

Since IC was invented by Jack Kilby in 1958 and commercialized by Fairchild in 1961, the tempo of that innovation had been truly remarkable and the integration density continued to increase year by year to finally reach the level of "Large Scale Integrated Circuits". The time machine flies into the latter half of the 1960's, and I would like to introduce some topics in the transition period from IC to LSI.

When talking about semiconductor innovations, it is "Moore's Law" that is always cited. For those engaged in semiconductors, Moore's law is, so to speak, a common sense, but this time I would like to start talking about its origin.

In 1965, when Gordon Moore, then 36 years old, was at the top of research and development at Fairchild Semiconductor, he contributed a paper titled "Cramming More Components into Integrated Circuits" to April 15th issue of the Electronics magazine. He systematically investigated the trends so far and discussed in what kind of form the degree of integration would grow in the future.

In making such predictions, he thought of a unique way. That is, the horizontal axis represented the year, and the vertical axis represented the number of components on an IC in the logarithmic scale with base 2. To put it flatly, he arranged the numbers as 1, 2, 4, 8, 16, 32, and so on, on the vertical axis at equal intervals. Then, he plotted the transition of the integration density assigning "1" for 1959. He found that it was exquisitely on a straight line at 45 degrees. In other words, he noticed that "the number of components on an IC doubles every year".

However, since it was only several years since the IC was first made, there were only 5 plots in total. These very five plots are the origin of "Moore's Law". I cannot help being surprised that it still remains as an important rule to predict the progress of semiconductors even today, after more than 40 years since his prediction.

At that time the components per chip was about 64. Extrapolating the trend, Moore predicted that in 1975, or 10 years later, it would be possible to integrate 65 thousand components, or 1,000 times more than in 1965. It was a tremendous forecast beyond the common sense at the time. Furthermore, he argued, as a result of such large-scale integration, that it would be possible to create something drastic in the future, such as home computers which could not have been even considered before. When we think about the fact that the first personal computer came out about ten years after this paper, it shows how exquisite was his insight into the future.

Even though the term LSI was not used in Moore's paper, it actually predicted that the era of LSI would come in the not too distant future. As I touched in the Episode 3, the first time I came across the word LSI was at the ISSCC (International Solid-State Circuits Conference) in February 1966, while I was studying at Stanford University. The theme of the keynote session of the conference was LSI, and Jack Kilby, who was already famous as an inventor of IC, made a keynote speech. It

was a speech about a technology that could integrate hundreds of gates, when the actual IC integration level was still only a few gates, and the impression I got was somewhat shocking.

In the report after returning to Musashi Factory of Hitachi from the study abroad, I strongly emphasized this point and made a proposal to my bosses that “we should prepare for the age of LSI as soon as possible at Hitachi”. The proposal was accepted by Masami Tomono and Shotaro Shibata, and I was transferred to Central Research Laboratories in 1967, one year after my return from the US. I was assigned to LSI research in the group of Minoru Nagata. It was, however, only for one year that I was involved in LSI research activities there. In the following year of 1968, I was relocated to the Musashi Factory again. It was to prepare for the coming era of LSI as a design manager. Movement in every year from one facility to another was not a usual practice, especially in the established giant company like Hitachi, but it was a special time when the field of semiconductors was on a jumping board for a big fly.

The LSI era suddenly started when Sharp released the world’s first LSI calculator “Microcompet QT-8D” in March 1969. The calculator was composed of 4 LSIs and 2 ICs, and it was much smaller and lighter than conventional models. The price was 98,000 yen, which broke the critical line of 100,000 yen for the first time in the calculator history. With the advent of this calculator, the full-fledged LSI era finally took off.

In preparation for the era of LSI, a major revision of personnel and organizational changes, which had never been precedent at Hitachi, was carried out in November of 1969. At that time, Hitachi’s basic organization was a unique “factory profit center” system, which meant that the responsibility for the operational profit resided with the factory manager. Therefore, all the essential functions of business operation such as design, manufacturing, and control functions were concentrated under the factory manager. In other words, the factory was like “the castle of the nation”, and the factory manager was like the king of the castle.

In the new amendment, the exception to this rule was accepted for the semiconductor sector for the first time in Hitachi. By breaking the previous rule, it was to change the basic organization to the system of “business division profit center”, meaning the responsibility of the profit resided with the business division manager. In other words, it was a shift from “How to make?” oriented organization (factory-centered) to “What to make?” oriented organization (business division centered). Along with this line, the design and development department moved to belong to the business division from the factory.

In parallel with the organizational change, significant changes in the personnel placement were conducted by promoting younger generation to higher position. And to my surprise, I was appointed “Department Manager of Product Development Department” at the age of 32. This age was the record of the youngest Dept. Manager in Hitachi ever before and which never happened after. Nishida of “Process Development Dept. Manager” was 33 years old, one year older than me. The record making personnel affair was taken up in various newspapers, magazines, etc. The biggest one that took up in article was the evening paper Fuji (December 7, 1969 issue) shown in the picture below.

Using all of the front page, it reported the details with the title “Big Surprises! for the Board of Directors, congratulatory friends, and even for the person himself” The expression for “Big Surprises!” in Japanese, “Atto Odoroku”, was a quote of a part of the phrase which was popular in the street as TV gag at that time. In addition, there were lines of bold letters in the page with excitement, such as “Wild Hitachi, 32-year-old Dept. Manager”, “young brain in blooming electronics”, “Only 10 years of tenure in the company, and shocked colleagues of the same year.”



Fig. 5.1 The top page of Evening News Fuji (December 7, 1969 issue)
The author at top in the middle

The Weekly Post took up a top article, “32-year-old Dept. Manager selected by “management battleship Hitachi”, “Why did the famous mammoth enterprise known by its “slow promotion” take it up?”

Under such circumstances, I had an interview with the writer Saburou Shiroyama who had already established his fame as the master in the literary world at that time. This interview is still unforgettable for me. Although, it was an hour of nervousness, his sentence was very carefully summarized when I read it at a later date, and I felt very grateful and relieved.

Such a major change in organizational structure and major rejuvenation of personnel affairs was unprecedented reform in Hitachi, and it was decided by the then President Kenichiro Komai in response to a proposal from Tadayuki Takei and Masami Tomono, the executives of the semiconductor division at that time. Kenichiro Komai made his comment on the newspaper "The age of LSI is coming. It is a major, unprecedented change in the electronics industry. It is quite different from our traditional culture of heavy electric machinery. We should make use of brains of younger generation in this dynamic field". It was a renewal of Hitachi's traditional system to cope with the coming LSI era, and at the same time, it was a reform that symbolized dynamism and flexibility of Hitachi's management at the time.

However, in a large company like Hitachi, this kind of special promotion cannot be simply considered as "I am happy and honored" feeling of an individual. I still remember an advice on this point from one big senior. "This promotion may be a great honor for you, but this kind of unusual promotion would never be possible in the heavy electric business groups. You know the old saying "A nail that sticks up is hammered down". The special promotion this time means that you are "a nail that sticks up" inside the company. You should keep it in mind."

This senior intended to say that Hitachi's mainstream was the heavy electric field, and the semiconductor is still a sub-stream as a new comer. His advice means that if a sub-stream person comes out too much, he will be beaten. At first it did not strike home, but after a while I knew the real meaning of his words. At that time, there was no knowing that the time of deep valley would come with the advent of the semiconductor major depression, like the truth of "a valley is deep if the mountain is high". And this is the dynamism of semiconductor industry, later called "silicon cycle", and I will touch on this subject later.

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