The Restructuring of Japanese Semiconductor Industry

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[abstract]
This paper reviews the development process of Japanese Semiconductor manufacturers and makes clear some problems that they are facing now. Especially, this paper focuses on their fundamental trends. Furthermore, I try to clear the five tasks which Japanese Semiconductor manufacturers have to solve under the severe global circumstances. It is important for them to achieve the five tasks for their prosperity. They must confirm their targets clearly and develop a unique semiconductor, the system LSI (Large Scale Integrated Circuit) and the new IC (Integrated Circuit). They should seek the new global standards on IC to control the behavior of competitors. So, it is necessary for them to carry out the huge investment for R&D, the new infrastructure and the employment of the many powerful engineers and workers. This paper refers to the nature of global competition and the strategies of Japanese IC manufacturers. They must pursue still greater efforts for the restructuring and rationalization. They carry out a rationalization of manufacturing process and their business aggressively. Furthermore, Japanese Semiconductor companies try to form the strategic alliances with American semiconductor producers or other companies to make the efficient use of the outside resources.

1. The Development Process of Japanese IC Manufacturers

(1) First Stage (1962-1980)
This paper focuses on the fundamental trend of Japanese IC Manufacturers. IC was invented by American manufacturers at the end of 1950s. In 1964, IBM developed 360 computer type that was a result of the strength in their software engineering. And IBM 360 used IC. Japanese IC Manufacturers could not develop IC and software in those days. They have little license about IC technology.

1) Imported technologies
In the first place, Japanese IC Manufacturers had to depend on American technologies. They imported American IC technologies or purchased the patents of them. In 1962, NEC introduced an important IC license from Fairchild. Other Japanese semiconductor...
producers tried to get the technology transfer from American companies. They purchased many technologies from American companies and have developed them further. Thus the Japanese IC industry started from the beginning of 1960s.

2) Japanese IC Manufacturers promoted the mass production of the memories and enjoyed a big domestic market. Since 1964, Japanese IC Manufacturers have expanded their products and their markets rapidly. They established the mass production systems of IC. Especially, they carried out the mass production of Memory for the computer, TV and VTR. The mass production of Memory resulted in lowering its cost. In 1968, the total amount of Japanese IC exceeded that of the imported IC. Step by step, Japanese IC Manufacturers have strengthened its competitive powers.

3) Industrial Policy.

In 1970s, the MITI set up the policies to support Japanese semiconductor producers so that they could catch up with their American counterparts. In 1976, MITI mapped out the VLSI (Very Large Scale Integrated Circuit) development program with Japanese semiconductor producers. Then the major aim of the program was to catch up with American industry. MITI and Japanese semiconductor producers invested about 35 billion yen respectively to build up the VLSI Development Association. At the end of 1970s, Japanese IC Manufacturers went ahead of American IC development at the memory.


1) Japan as NO.1

The Japanese semiconductor producers have achieved the rapid progress. In 1986, the Japanese semiconductor market exceed that of the U.S. and NEC took the highest share of the world market. The total sales by Japanese IC industry and the number of their employees continued to increase during those periods. Japanese IC companies have enjoyed the Japanese style of rapid development. They have the domination over the world Memory market. American industry carried out the restructuring and built up SEMATECH. INTEL has stopped producing Memory and concentrated on developing MPU (Micro Processor Unites). American industry has tried to get outsourcing of many electronic parts from Asia.

2) The progress of Asian semiconductor producers

As the Cold War came to an end, Socialistic countries have tried to introduce Market mechanism. And Asian NIES and ASEAN countries have made the rapid economic progress. They received many foreign direct investments. They are producing the electronic goods. The new products are developed simultaneously by the IC producers at the world. The business related to correspondence, broadcasting and information were rapidly expanding all over the world. These businesses have a common characteristic in which the computers and networks play the important role. The new competition took place all over the world. Taiwanese and South Korean semiconductor producers had the strong competitive power and expanded their world market shares. Especially, the prices of their goods are cheaper than those of Japan. Taiwanese semiconductor producers have experienced OEM productions of American semiconductor producers. Now, they become the strong competitors for Japanese semiconductor producers. Samsong produced the biggest volume of 16 MDRAM. They introduced Japanese technologies and employed Japanese engineers. They put money into the many new equipments.

3) The offensive of American semiconductor producers

On the other side, American semiconductor producers abandoned Memory production and devoted their energies to the MPU productions. The American semiconductor producer, Intel, concentrated its capacity for the production of MPU. In 1986 and 1991, they reached the semiconductor agreement with Japan. Japanese semiconductor industry opened its domestic market for the foreign competitors further more. In 1991, Intel

took the highest share of the semiconductor market in place of NEC and in 1993, the volume of the American semiconductor market exceeded that of Japan again. Intel's share soared up to 70% of the world MPU market. Micron Technology tries to develop the cheaper and smaller Memory chips. American industry has begun outsourcing of the electronic parts from Asia. Intel, Microsoft control the global standards of PC's MPU and OS (Operating System).

4) Restructuring
Since 1990, Japanese economy have experienced a structural change and the severe recession has hit Japanese economy. The collapse of Japanese bubble economy exerted a negative influence upon Japanese economy and resulted in many bankruptcies. The down-sizing of computers and the recession have caused them serious damage. So, Japanese semiconductor market is coming smaller than the U.S. market. In this process, Japanese IC companies confronted with the new competitive circumstances. Japanese semiconductor producers were sandwiched between Taiwanese and Korean semiconductor producers on the one side and American semiconductor industry on the other. Japanese IC companies must carry out the restructuring and implement the new strategies under the severe international competitive circumstance. They reduced the number of workers. They tried to shift some parts of their factories from Japan to Asia. On the other hand, in 1990s, Japanese semiconductor producers sought to the restructuring and closed some foreign factories. They stopped some their weak businesses.

In 1997, NITETSU Semiconductor stopped the construction of 64 MDRAM (Dynamic Random Access Memory) manufacturing process. Many main Japanese semiconductor producers, NEC, HITACHI, TOSHIBA built up new joint ventures together with their competitors. Other semiconductor producers carried out M&A. NEC and HITACHI established Elpida Memory Corp Ltd., (1999) to produce DRAM. Japanese government also supported those projects.

2. The Strategies of Japanese IC Companies
Japanese IC companies place much emphasis on the strategies of R&D, rationalization and globalization.

(1) The Development of R&D
The total amounts of Japanese exported IC products exceeded the imported products in 1993. But, at the electronics industry, the total amount of imported technologies are exceeding that of the exported technologies. The competitiveness of Japanese MPU producers were not strong. Intel is controlling MPU (Micro Processor Unites) market. The semiconductor is an international commodity and its new generation products are simultaneously developed by main semiconductor producers all over the world. The creative powers of Japanese R&D systems stay at the lower stage in spite of the large R&D investments. In 1990s, under the severe recession, Japanese IT companies can not invested a large amount of money in the R&D operations as South Korean semiconductor producers. So, their international competitiveness have remained at the low stages. They must pioneered the new frontier. If a semiconductor producer is not able to obtain the global standard of new product, it will lose its investment. At first, they concentrated the production of special IC. And Japanese semiconductor manufacturers aim at the development of the next generation items such as 65 nano meter design making full use of automatic design tools. Another aim for Japanese semiconductor producers is the development of system LSI (Large Scale Integrated Circuit). It includes MPU, Memory and other functional devices for the specific uses. They treat system LSI as an important product because they have a strong competitive edge in their productions.

(2) **The Pursuit of Rationalization and Productivity**

Japanese semiconductor producers succeeded in producing 300mm wafer as a material. They can acquire more chips from that wafer and put it to the practical use. Japanese semiconductor producers place a stronger emphasis on the production of the small package of IC and the bare chips for the portable telephone. They try to produce many smaller IC with the high speed machines.

Since the price of 16 M DRAM has fallen at 400 yen because of the severe competition, Japanese semiconductor producers must try to reduce the IC cost. The machines which produce IC are very expensive. So, to cut these prices, Japanese semiconductor producers are promoting the spread of their standardization. Moreover, they carried out the module and packaging of manufacturing process. They standardized the management system for the manufacturing process. They accomplished the restructuring and reduced the number of their employees. Japanese IT companies abandon the lifetime employment system. They promote the management innovations and employ many temporarily workers. They try to reform JIT (Just In Time system) or Keiretu.

(3) **The Spread of Globalization**

The main Japanese semiconductor producers have several foreign operational plants or several foreign operational centers. The international production divisions of Japanese semiconductor manufacturers are expanding throughout the world. And they enlarge the overseas OEM productions. Japanese semiconductor producers try to introduce the world optimum productions or the world optimum purchases. To do so, they realize a cost reduction and secure still more the flexibility.

Japanese factories were becoming the mother factories for their foreign firms. On the other hand, they need a lot of money and have to bear high risks to develop the new semiconductor. So, they are trying to form a strategic alliance with American semiconductor producers to make efficient use of outside resources.

(4) **The Modern Situation**

In the 21 century, Internet revolution is happening in the world. Each correspondence company tried to obtain many business chances and caught the great interest in the information businesses. Many cases of M & A have been witnessed in digital businesses all over the world. Especially, American companies control Internet revolution. American ICT companies are taking the leadership on the internet businesses. And U.S. government developed NII (National Information Infrastructure plan) and GII (Global Information Infrastructure plan). American semiconductor producers control many worldwide standards, while Japanese semiconductor producers are subject to the standards of their American counterparts. On the other hand, Taiwanese and South Korean semiconductor producers are coming to the fore. Samsong takes the highest shear at world DRAM market. Taiwanese and South Korean semiconductor producers have maintained the strong competitive power.

Of course, some Japanese companies achieved the high performances. TOSHIBA makes a profit on developing the flash memory. The portable telephone, digital camera, DVD, new type TV and car electronics IC influence on the good performance of Japanese IC companies. But, the international competitiveness powers and creative powers of Japanese IC companies remain the low levels in spite of large R&D investments. SANYO has the deficit.

**3. Five Tasks of Japanese IC companies**

One more again, they are carrying out the many strategies under the severe competitive circumstance. They must seek the new way of strengthening their international competitiveness. Japanese IC companies
have to achieve the higher productivity. They must promote their process innovation and the management revolutions. To develop EC (Electronic Commerce) and to strengthen the international competitiveness, Japanese IC companies have to create the new ground, new products, new manufacturing systems and new business models beyond the FMS (Flexible Manufacturing System). They should seek to reform their business aggressively. It is necessary for Japanese IC companies to develop the next five tasks.

(1) Brush up Their Originality

It is a fact that the Japanese high telecommunications society gives them a chance of prosperity. The Japanese government plan to establish the e-Japan. Japanese semiconductor producers have the new business opportunity under the high telecommunications society. They have to confirm their targets clearly and to develop the unique semiconductors and the system LSI. Japanese semiconductor makers aim at the development of the next generation memory. They want to develop the many new products, especially the portable telephone's smaller IC and car electronics IC. IC companies must strengthen international competitiveness especially by developing new IC. They must move from the imported technologies to the independent, home-grown technologies. They must pioneer the new frontier and become the dominant players in this specialized market. Then to accelerate the progress of new IC and system LSI, they have to organize well the information infrastructure.

Under those new circumstances, IC producers have to establish the important global standards. Japanese IT companies have a few important licenses about IC and the tempos of their strategies or innovations are too rate. It is important for the worldwide IC producers to have a global standard. Japanese IC companies must meet the foreign standard requirements. The new global standards on IC control the behaviors of IC companies. Of course the global standards that fail to take account of the market mean nothing. Japanese IC companies have to pay attention to the global standards on the semiconductors and the IC market trends. So, to cope with the global standards about IC, they have to establish their new powerful standards. If a semiconductor producer is not able to obtain the global standard of the new product, it will lose its investment.

(2) Bring up the Powerful Researchers, Engineers and Workers

Japanese semiconductor producers must pursue still greater efforts for the restructuring and rationalization. Under the severe recession, Japanese IC companies have not respected their workers. They promote the management innovations and employ many temporarily workers. And they enlarge the overseas OEM productions and EMS (Electronic Manufacturing Service). To do so, they realize a cost reduction and secure still more the flexibility. Now, Japanese IC companies must pay serious attention to the originality of IT workers and engineers. They have to rear the creative workers and engineers. Especially, their originalities should be guaranteed by superior working conditions. Japanese IC companies must correct the wrong working conditions that are unfavorable to the workers and engineers. They have to encourage the creativity in the workplace to instill pride in the workers. They bolster their morale. They have to introduce the different cultures and peoples.

(3) Carry out the Huge Investment

Japanese IT companies sought to reform their business aggressively. They needed a lot of money and had to bear the high risks to develop the new semiconductors. They obtain many patent rights on the world markets by the huge R&D investment. Main Japanese IC companies invest about 4 billion dollars for

R&D by every year. They are promoting the huge R&D investment and strengthening the civil and government relations again.

Furthermore, Japanese semiconductor producers must promote their process innovation. They are establishing many new factories by the huge investment. Of course, their factories can treat 300mm wafer and introduce the modern plants and equipment. They improve their productivity and realize the better mix of many products.

They must try to reduce the production costs for their survival. IC machines are very expensive. So, to reduce the production costs, Japanese semiconductor producers standardized the management system for the manufacturing process. Moreover, they carried out a module production and the packaging of manufacturing process. They tried to concentrated the production of special IC and stopped the construction of planned manufacturing process.

(4) Realize the Various Strategic Alliances

Coming up to the world market, Japanese IC companies have built up many strategic alliances with their competitors. They tried to form the strategic alliances with American semiconductor producers or other companies to make the efficient use of outside resources. On the other hand, they try to divide their businesses and wind up the unprofitable business.

Several main Japanese semiconductor producers, NEC, HITACHI and TOSHIBA are building up new joint ventures together with their competitors. Japanese government also set and support the new joint projects with the companies. HITACHI and MITSUBISHI built up new joint ventures Renesas Technology Co.,Ltd.(2003) to produce the system LSI. The Japanese government also set about those projects. Other semiconductor producers carry out M & A (Merger and Acquisition). Through the M&A and the strategic alliances, Japanese semiconductor producers are expanding their business. Especially, Japanese IC companies seek to enlarge the solution businesses.

(5) Conclude FTA (Free Trade Agreement) and EPA (Economic Partnership Agreement)

Furthermore, beyond the global standards, it is important for Japanese IC companies to build up the new Asian economic framework such as the Asian free trade zone to cope with many other countries.

They have to achieve the internationalization through the establishment of an Asian economic sphere, working towards Asian independence rather than simply seeking the cheaper labor there. The establishment of new international economic framework such as FTA and EPA and the reorganization of industrial structure will present the chances of prosperity for Japanese IC companies.

Japanese IC companies have exported many their products and have tried a large foreign investment for Asia. From 1999, Japan and Asian economic relations are becoming a large and strong one again. It is necessary to increase the wealth of one country in harmony with the rest of Asian world. So, their tasks are to conquer the Asian financial crisis, to support the Asian industrialization and to establish the economic growth center with Asian countries at the new stage including ICT revolution. Under the new circumstances, they will discover the big business chances.

4. Conclusion

This paper reviews the development process of Japanese IC Manufacturers and makes clear some problems that they are facing now. This paper focuses on their fundamental trend and tries to clear the five tasks which Japanese IC Manufacturers have to solve under the severe global circumstances. They carried out a rationalization of the manufacturing process. They must pursue still greater efforts for the restructuring and ra-

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tionalization. They seek the cost reduction by the introduction of mass production: scale merit, the cheap labor and EMS (Electronic Manufacturing Service).

Japanese IT companies tried to form the strategic alliances with American semiconductor producers or other companies to make the efficient use of outside resources. It is necessary for them to depend on these strategies. But these strategies are not enough for them. Their competitors will can imitate the introduction of mass production, the cheap labor and EMS without difficulty.

It is most important for them to develop a new IC or to keep the originality. They have to brash up their ability of R&D. They must confirm their targets clearly and develop a unique semiconductor, the system LSI and the new IC. They should seek the new global standards on IC to control the behavior of competitors. So, it is necessary for them to carry out the huge investment for R&D, the new infrastructure and the employment of the many powerful engineers. They have to develop the unique products and promote the innovations.

Furthermore, they must achieve the internationalization through the establishment of an Asian economic sphere, working towards Asian independence rather than simply seeking the cheaper labor there. So, they have to search the world and Asian industrial trend and restructure the world-wide R&D organization. The establishment of new international economic framework and the reorganization of the industrial structure will present the chance of prosperity for Japanese IC (Integrated Circuit) Manufacturers.