SEMICONDUCTOR INDUSTRY OF KOREA

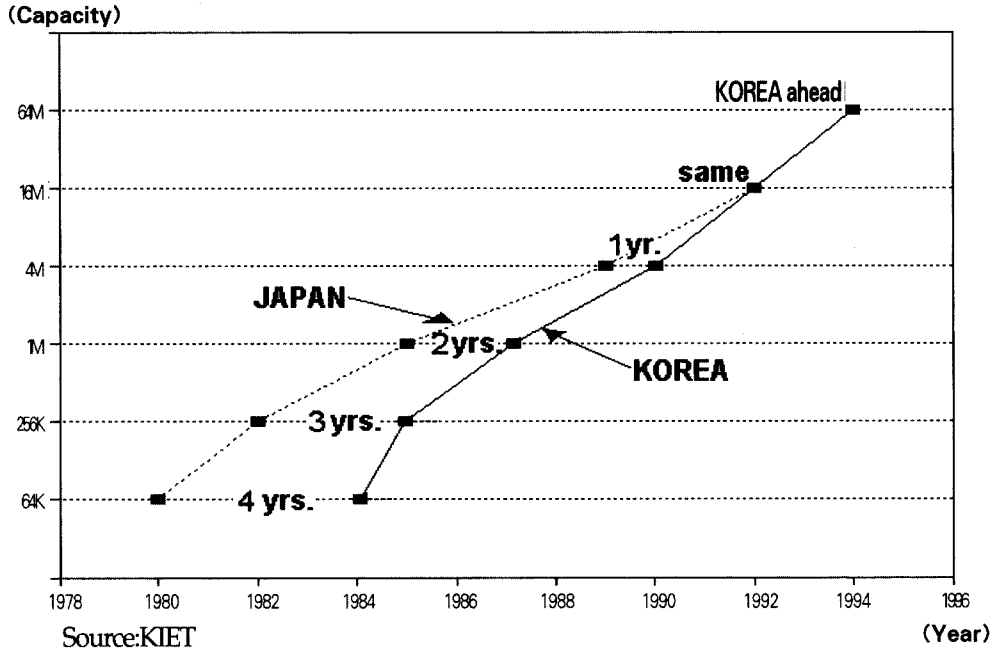
Development Path and Current Status

The Korea's semiconductor industry began with the development of the 64K DRAM in 1983. The design and process technologies for its development were imported from the U.S. and Japan. At that time the world memory chip market was dominated by Japanese firms, while U.S. firms were being crowded out of the market. No one expected that Korea would be a strong competitor to Japan. But Korean firms have made the gap narrower by continual effort in R&D and huge investment.

Now more than 10 years later Korea's position in memory chip market is equal to Japan. In the case of 256M DRAM, Korea developed the fully working die, ahead of Japan. In the process technology, Korea is said to be ahead of Japan for the fact that the yield(the rate of actual good dies from one wafer) in Japan is around 80% while that in Korea is near 90%.

With these accomplishments, the Korea's share of the memory chip market expanded from 9.7% in 1990 to 21.6% in 1994. Considering the fact that no fewer than 9 major memory chip makers are in Japan in contrast to only 3 major makers in Korea, its large market share is amazing. Among these three Korean makers, Samsung is ranked the first while LG and Hyundai are ranked the 9th and 10th largest in the world memory chip makers respectively. This means all three Korean makers are among the world 10 top chip memory makers. From next year on, when the 16M DRAM enters

Comparing the development points of each DRAM sample



Source:KIET

the market, the Korea's share is expected to be about 40%. Due to the rapid rise of Korean firms as described above, the Japanese firms are concerned that they will be crowed out of the market by the Korean firms in much the same way as the American firms were crowded out by the Japanese firms.

These remarkable achievements, however, are limited to the product development and market share in the field of memory chips. Aside from this field, Korea's overall semiconductor industry is far behind that of the advanced countries such as the U.S. and Japan.

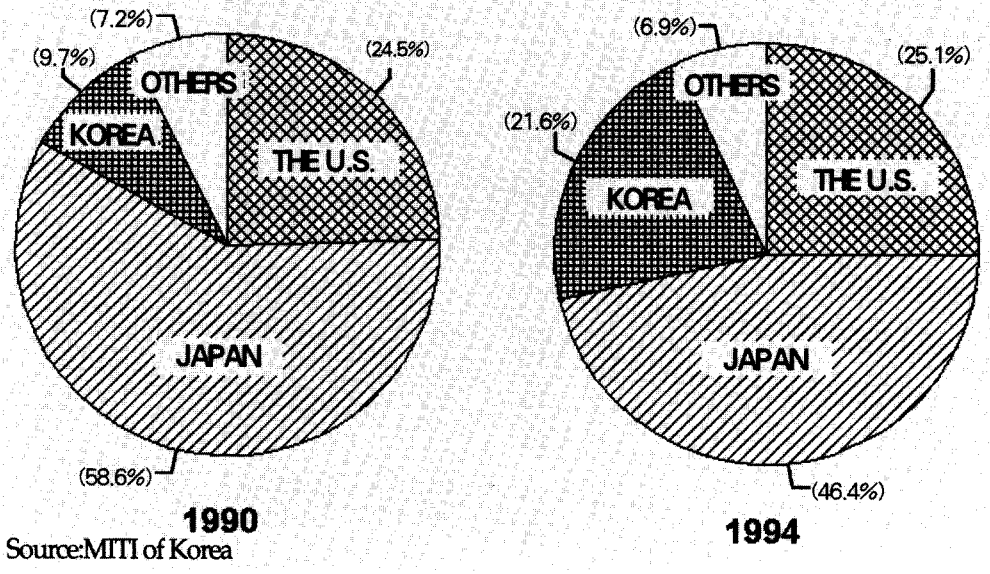
When it comes to technologies other than process technology, e.g., design, basics, material, equipment, Korea trails behind many advanced countries by 2 to 8 years. And in regard to product structure, 86% of products are memory chips so that Korea semiconductor industry relies too heavily on specific products. The foundation of Korea's semiconductor industry is weak, as it is based only on process technology and memory products but not on anything else.

Another weakness of the industry is that most of the semiconductor equipment was imported. At present only 12% of all necessary equipment is produced domestically, and even domestic equipment is usually confined to equipment for assembly or for test. In wafer fabrication equipment, the level of domestic production is no more than 4%. Therefore, the level of technology in equipment production is low and just in its infantile stage. If Japanese technological level is set at 100, Korea's technological level of wafer fabrication equipment is estimated at about 10, that of test equipment at 10, and that of assembly equipment at 30.

Environmental Changes and Challenges

The serious obstacles to better development in semiconductor industry in Korea are those problems pointed out above, i.e., too much

Change of shares in the world memory chip market



Source:MITI of Korea

reliance on process technology and memory products and the weakness of producing equipment parts. It will be more difficult to continue growth in the future if the Korean semiconductor industry does not amend these deficiencies. The environment around the semiconductor industry is changing, thereby increasing the weakness related to unbalanced structure. The changing environment in the semiconductor industry is as follows.

First, the efficiency of investment in memory chip is decreasing. While the investment required for development and production of one generation of DRAM is increasing rapidly, its life cycle is getting shorter. It is known that the investment in one generation has increased by two to three times over that of the previous generation. In the case of the 256M DRAM the total necessary investment is expected to be $3.8 billion. Recently the length of DRAM life cycle has shortened from 4 years to 2 years. This means while the investment cost is increasing rapidly, the time during which the firms can retrieve these cost is shortening.

Second, non-memory chip parts, such as ASIC (Application Specific Integrated Circuit) are becoming more important than the memory chip sector. It is due to the changes in demand and expanding technology. On the demand side, the trends toward multimedia is speedily expanding, while the communication, the consumer electronic and the computer are being integrated into one, thereby increasing the demand for chips capable of performing new and various functions. On the technology side, the miniaturization is occurring rapidly, so that the "making one chip" that can integrate a whole specific system into one chip is proceeding ahead. Owing to these changes, more non-memory chip products for various uses are needed. Among them, the most focused product is ASIC, which is a chip made for specific applications including accepting customers' orders and needs.

Third, as the Korean semiconductor industry becomes a member of the leading group in product development, it faces more difficulties in product development because of the weaknesses in the

Technological level comparison in the equipments

	KOREA	JAPAN	The U.S.
Wafer Fab. Equip.	10	100	70
Test Equip.	10	100	100
Assembly Equip.	30	100	60
Supplementary Equip.	60	100	70

Source:KIET

equipment base. In the DRAM industry, whenever one generation of products is developed, the equipment for that generation needs to be developed together. In the past, since Korean firms developed their products after the development in advanced countries, they could import the equipment from the advanced countries. Given that Korea has now equaled advanced countries in product development, however, Korean firms should develop their own equipment. Now, without the foundation of the equipment industry, it is impossible to initiate mass production while keeping share of the market.

Future Directions to Take for Progress

To continue its progress, the Korean semiconductor industry should overcome its weaknesses and respond and adapt to the changes in the industry.

The industry's response should consist of, first, large scale augmentation of investment in the R&D for design and basic technologies. Recently Korean memory chip makers are thriving because of the memory chip boom and the cripplingly high value of yen. Now is the time to invest heavily in these weak fields. It will also be a good policy to invest in it or acquire American venture firms in order to learn new technologies in these fields.

Second, the corporate culture should be changed in accordance with the change in the industry. Since the ASIC is rising as a core field in the semiconductor industry, the most important task is to obtain competence required in the design technology. The basis of design technology is different from that of process technology. In ASIC, what is needed is not the well-run organization but creative individuals. Creativity grows best in a culture which accepts and encourages the idiosyncrasies and irregularities. Therefore, the Korean corporate culture should incorporate this fact.

Third, to develop an equipment industry it is necessary to encourage cooperation between chip makers and equipment makers. First of all, a joint project which all chip makers and equipment makers take part in should be established. The target of this project should be the development of items which can be produced in the near future and which have broad use. Each firm should take the charge of each item or research theme respectively to reduce the time and effort. The developed equipments are to be used by all the chip makers. And the experiences of joint activities like this should be the basis for a continuing cooperation in the future. Using this experience as a springboard, Korea should be able to leap to the forefront of core wafer fabrication equipment development.

Related to the development of equipment, joint ventures and alliances with foreign firms and the inducement of direct investment from advanced foreign countries will be of great assistance to acquiring advanced technologies. Many Japanese semiconductor equipment makers have grown out of trading companies that import equipment through joint ventures with the famous worldwide equipment makers. Especially, strategic alliances with advanced foreign companies in areas where our technologies lag behind should be pursued vigorously. It is also necessary to improve the environment and simplify the rules governing foreign investment.

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