

Strategic Alliances in Semiconductor Industry : New Strategies for Japanese Companies

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1. Introduction

Technological advancement generates tremendous changes of markets and competitive structures in the information era. With these changes, alliance relationships in the information technology industry have become as complicated as before. They might reflect not only the change of industrial structures, but also changing strategies of individual companies. Thus we will investigate them, focusing on the semiconductor business.

(1) Overview of Semiconductor Industry

In the 1980's Japanese companies caught up with American companies by investing their resources on DRAM (Dynamic Random Access Memory) and they have kept their top position since the latter of 1980s. However, in the 1990s American companies improved their performance in the field of MPU (Micro-processor Unit), in which Japanese companies fell behind. With falling growth rates, Japanese companies now face red ink.

However, just because American sales of semiconductors are surpassing that of Japanese firms, it does not mean that the US firms are taking a commanding lead in all fields. The one reason why Japanese companies grew so rapidly in the 1980s is that there was strong demand for computers, home appliances and elec-

Table 1-1 Global Competition of Semiconductor Business¹⁾

Rank	1981	1992	1993	1994
1	TI	NEC	INTEL	INTEL
2	MOTOROLA	TOSHIBA	NEC	NEC
3	NEC	INTEL	MOTOROLA	MOTOROLA
4	HITACHI	MOTOROLA	TOSHIBA	TOSHIBA
5	TOSHIBA	HITACHI	IBM	IBM
6	NS	TI	HITACHI	HITACHI
7	INTEL	FUJITSU	TI	SAMSUNG
8	MATSUSHITA	MATSUSHITA	FUJITSU	TI
9	PHILIPS	PHILIPS	SAMSUNG	FUJITSU
10	FARECHILD	NS	MITSUBISHI	MITSUBISHI

tronics in the Japanese market. Now, the demand is strong for personal computers, a field in which US-made chips have an advantage.

In fact, some Japanese companies have improved their performance as a result of increasing demand for personal computers in the American market. However, there is not much expectation that Japanese companies will improve their growth in the future as long as they focus on DRAM production. According to market forecasts of WSTS, MPU has much higher growth rates than DRAM from now on. Intel is the best positioned company as business shifts from DRAM to MPU²⁾.

If Japanese companies keep falling behind in the field of MPU, Japanese companies will allow American companies to take hold on the core processor

1) This table were drawn based on data from Data Quest.

TI = Texas Instrument, NS = National Semiconductor

2) Intel has consistently focused its resources on developing the next product before other, quickly coalesced a group of customers and suppliers around the new products and markets as they have matured and become too price competitive.

technology in the emerging multi-media society. What is worse, the competitive advantage of Japanese companies, the process technology of DRAM, is no longer the technology driver for semiconductor production. Recently there is no difference between production of MPU and DRAM.

There are yet other competitors for Japanese companies. Korean Electronics firms, such as Samsung, Hyundai and LG, have been concentrating their resources on the DRAM field to catch up. Korean companies might reach the level of Japanese companies in scale and technology, according to some reliable resources. In fact, a Korean company, Samsung has entered into OEM agreements with some Japanese companies to build very sophisticated production equipment.

(2) Research Question

Japanese companies are exposed to severe competition and difficult market conditions. In the DRAM field, Korean companies have caught up with Japanese companies in technology. Meanwhile American companies dominate the market for core products such as MPU. Japanese companies need new business strategies for the future.

However, there are not so many options for Japanese firms. They have no choice but to build on advantages they have in the DRAM field. However in the DRAM field, it is becoming increasingly difficult to develop strategy based on with a single company's resources, because of intense global competition, the increasing importance of defacto standards, and the increasing cost of research and development.

The purpose of this paper is to consider how strategic alliances evolve and change, what characteristics recent strategic alliances have. In addition, we look into how Japanese companies should manage the alliances for re-growth.

These research questions will be illustrated by two case studies, involving

Toshiba and Hitachi. The reason why we have chosen these two companies is that they have similar business structures and are focusing on DRAM as their core businesses.

2. Case Study 1 : Toshiba

(1) The Outline of Toshiba's Semiconductor Business

Toshiba was established in 1939 by the merger of two electrical equipment maker, Shibaura Manufacturing and , Tokyo Electrical Company. During the high economic growth period after the second world war, Toshiba grew with heavy electrical equipment as its core business, and has now become a leading company worldwide. It occupies second place after Hitachi in electrical machinery, with gross annual sales of 361 billion yen in 1990, and assets of 3.214 billion yen. However, Toshiba's current performance is supported by new information and communication-related business rather than heavy electrical or home appliances manufacturing. Toshiba appeared as a leading company in the semiconductor business in 1982 when the "W-strategy", aiming to further advance the company's strength in the semiconductor business, was implemented. "W" had two purposes, that first, to win competition in the semiconductor business, and second, to develop that business world wide. It was an very ambitious strategy.

In order to implement this strategy, Toshiba aggressively invested in the semiconductor business when rival makers, Hitachi and NEC, did not dared to invest. Toshiba continued to invest heavily to establish clean rooms and LSI research labs. The amount of investments rose to \$5700 million from 1983 to 1988. The Investment were five times as large as before the implementation the W strategy, and as a result Toshiba overtook Hitachi in 1987, taking the second position next to NEC in the world market.

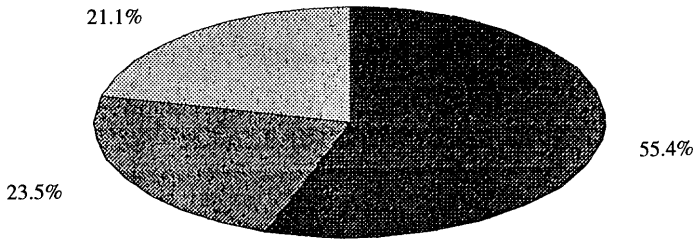
One of the aims of the W strategy is to develop a solid and balanced base in

memory, logic, bipolar IC. For example, except for Bip Digital and Micon, Toshiba occupied top three position in world in other product fields. This balance is the main characteristic of Toshiba's business structure.

On the hand, one feature of Toshiba's semiconductor strategy is overseas operation. Hitachi, NEC, Fujitsu have rushed to increase their production capacity overseas as a reaction to the appreciation of the yen. However, Toshiba still sticks to domestic operations, keeping high export rates compared with rival companies.

Even though Toshiba manufactures semiconductors in Germany, US, and Malaysia, these are only post-processing operation. In the case of pre-processing, improvement in manufacturing are of the utmost importance to maintain and raise profitability. In semiconductor production, pre-processing is the most important

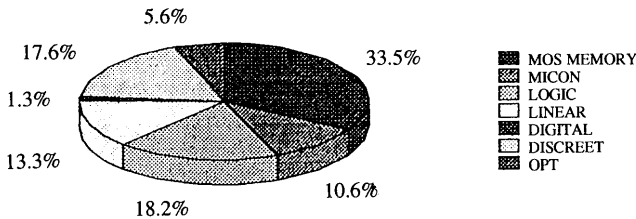
Figure 2-1 Performance of Toshiba¹⁾



Information

Heavy

Home



MOS MEMORY
MICON
LOGIC
LINEAR
DIGITAL
DISCREET
OPT

1) Toshiba Annual Report 1993

stage in the manufacturing process, so Toshiba keeps its pre-processing operation at home, where improvements in production are most easily implemented.

Toshiba's strategies seem to run against the trend of internationalization. However Toshiba has a unique approach to overseas investments. Toshiba has been building strategic alliances with many foreign companies. Other rival companies, NEC and Hitachi, also build alliances with foreign companies, but Toshiba is the only company which has experienced cooperation with foreign companies from R&D to production. Whenever there is an emergent need to move production facilities overseas, Toshiba can transfer them by taking advantage of its cooperation with foreign companies. Until that sort of emergent need arises, Toshiba strategically invest resources in order to enhance its competitive advantage in mass production technology for DRAM.

Toshiba's strategy has been based on the management of strategic alliances and refined mass production technology.

(2) The Development of Strategic Alliances

Toshiba started to build alliances with foreign companies before rival firms. Toshiba is quite open to acquiring resources which they have not accumulated previously from the outside. There is a principle for alliance in Toshiba ; when they build alliances with foreign companies the partner should be the best player in this field²⁾. Toshiba's alliances have been growing rapidly in number, but in the late 1980s there were not so many. Toshiba realized its strategic objective by deepening alliance relationships with two companies, Motorola and Siemens.

The alliance with Motorola started under the following circumstances : while

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- 2) To keep building strategic alliance with the best player, Toshiba has been emphasizing on R&D programs backed by high level of funding, advanced research facilities, and dedicated research teams which help maintain Toshiba's position at the cutting edge of new technologies.

Motorola was the world leader in MPU production in 1985, it had been forced out of the memory field due to competition from Japanese manufactures. In order to get back to memory manufacturing, it proposed a partnership with the leader in 1 M DRAM technology and mass production.

Toshiba, while it was the leader in 1M DRAM, along with other Japanese manufacturers, it was unable to compete with American companies in the MPU field. Toshiba had been looking to strengthen its operation in this area. In other words, the two companies' strategic intent for the future fit perfectly .

Since the establishment of a joint venture in 1987, the relationship has become closer and closer every year. For example, in 1988, Toshiba began selling 32 bit MPU in Japan with OEM supply from Motorola. At this time the MPU world market was dominated by two manufacturers, Motorola and Intel at this time. Both manufacturers were the only companies to produce and sell by themselves. Toshiba was the first manufacturer besides of Motorola and Intel to sell 32 bit MPU.

Toshiba's relationship with Siemens began in 1985 with providing Siemens with its DRAM technology. Building a partnership with Siemens placed Toshiba in a solid market position in Europe where Toshiba did not have a high level of recognition. The partnership also had the benefit of raising product image and expanding the sales networks.

The relationship between the two companies rapidly expanded in 1985 and in the following years joint development of one type of ASIC, the standard cell, and joint second source agreements were worked out. In 1989 the partnership was expanded as the demand for the standard cell greatly rose. Toshiba provides the design technology of Gate Array, which is said to have a market potential of \$4600 million, to Siemens. Since then Siemens has become a second source and vendor of this product. Through this alliance Toshiba increased its market share of Gate

Table 2-1 Major Alliances of Toshiba³⁾

Partners	Year	Content (Press Release)
Siemens	1987	1M DRAM Technology Transfer from Toshiba
Motorola	1987	Joint Venture from 1M DRAM Production
Motorola	1989	OEM Supplies of 16 bit MPU from Motorola
Motorola	1989	OEM Supplies of 32 bit MPU from Motorola
Motorola	1989	Joint Production of 256 Bit Static RAM
Siemens	1989	Technology Supply of Gate Array from Toshiba
Siemens	1989	Joint Development of Other ASIC Field
Echelon System	1990	Technological Agreement of MPU
Mips	1990	OEM Supply of Risk Chip from Mips
Motorola	1990	Joint Development of 4M DRAM
Synergy	1991	Technology Supply of Bipolar from Synergy
Pilkington	1991	Joint Development of High Integrated Gate Array
IDT	1992	Joint Development of Risk Chips
IBM	1992	Joint Development of Flush Memory
IBM and Siemens	1992	Joint Development of 256M DRAM
Synops	1993	OEM Supply of Design Technology on ASIC
Samsung	1993	OEM Supply of Flush Memory from Toshiba
National Semiconductor	1993	OEM Supply of Flush Memory from Toshiba

Array, which used to be weak. At the same time, joint development of ASIC led to the development of the next generation of standard cell which is 30% faster than the existing one.

The major characteristic of Toshiba's strategic alliances in the late 1980s is that other alliances developed around these two companies. In addition, acquiring technology and accessing foreign markets have been realized though the deepen-

3) Data collected from Nikkei Database

ing relationship with these two companies.

(3) Diversifying Alliance Relationships

Due to the rapid yen appreciation, and the increasing cost of R&D, it became more difficult to adopt to the competitive environment in the 1990s. So there were increasing needs to link up with external resources. In order to deal with the difficult environment, Toshiba diversified its alliance relationships and rearranged its their partners for strategic purposes. For example, Toshiba built an alliance with IBM in the flash memory business. They cooperated in fields of R&D, production, and marketing. Toshiba also made an alliance with Samsung Electronics in which Toshiba gives product information on flash memory to Samsung, and Samsung produces flash memory based on that information.

Toshiba also has a similar alliance relationship with National Semiconductor. The aim of diversifying alliance relationships is to get defacto standard in these products. In flash memory market there are two types of products competing, one is NAND which is developed by Intel, and the other NOR which is developed by Toshiba.

In order to meet the increasing cost of R&D for new product generations, such as 256M DRAM, Toshiba built alliances with IBM and Siemens for joint development in 1992. In the following year they succeeded in developing a prototype.

One characteristic of Toshiba's vertical alliances is that they are diversified for particular strategic purposes. To diversify relationships means not only realizing the strategic purpose but also hedging risk for the partners involved⁴⁾. The task of building, maintaining , and advancing the relationships is quite difficult in the

4) Interview with Yasuhiko Shibatsuji, Strategic Alliance and Contracts, Strategic Business Planning Office in Toshiba Corp., on 12. Oct. 1994.

semiconductor industry which is exposed to rapid technological and market change. In addition there are complicated relationships existing in the IC industry, involving both cooperation and competition.

To develop effective strategic alliances, companies have to build at least two core relationships with their partners, one dealing with existing technologies, the other dealing with next generation technologies. Toshiba has recently tried to find venture businesses having high potential for new technology development. In short, Toshiba build alliances with companies which are similar to itself in scale and have competitive advantage in the existing technological trajectory. At the same time , Toshiba builds alliances with venture businesses to find technologic seeds which lead to new technological trajectory.

Toshiba is involved in technological cooperation with Echelon to produce semiconductors for decentralized processing which allow contact with other processors and are installed into other machines. In the ASIC field Toshiba has built an alliance with Synapse to acquire design technology.

In addition to the companies mentioned above, Toshiba is actively promoting relationships with those companies possessing a high level of technology regardless of the partner's company name or its size.

3. Case Study 2 : Hitachi

“In order to raise efficiency of R&D and to proceed standardization of technology for flash memory, we make a cooperation with Mitsubishi.”¹⁾

Hitachi has built an alliance with Mitsubishi for joint research on flash memory technology. It is not unusual for both of them to build alliances with foreign companies, for the purpose of saving investment in R&D, plant and equipment, or shortening R&D time. But this alliance is different from others. The alliances be-

1) Hitachi Annual Report 1993

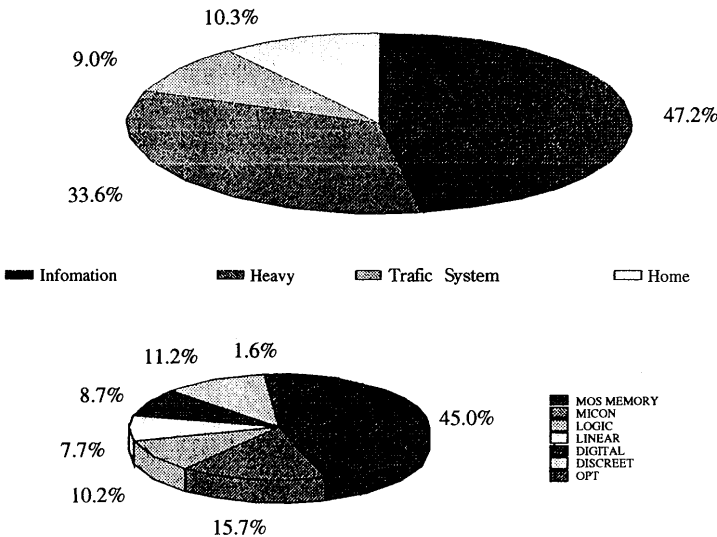
tween Japanese large semiconductor manufacturers tend to be avoided, because these companies are keenly competing in the same market in Japan and have until now had special sensitivity to each other.

Thus we can expect that Hitachi attempt to change its business strategy through the alliance.

(1) Corporate Business

Hitachi, whose market share of semiconductor business is 5th largest in the world, is one of the biggest comprehensive electronics manufacturers in Japan. Total amount of sale of the company is \$ 3,811 billion. It has three major business fields ; the first is a business field of heavy electrical apparatus like equipment for electric power and industrial and traffic systems ; the second is household elec-

Figure 3-1 Performance of Hitachi²⁾



2) Data collected from Nikkei Database

tronic appliances such as television sets, VTR and so on ; the third is information electronic equipment such as semiconductors, PC and telecommunication equipment. Though the household electronics fields has been very sluggish, under the influence of Heisei Recession in Japan, the heavy electrical apparatus field, which is a core business historically for the company, shows stable growth and supports the Hitachi group. Also the information electronic equipment business is increasingly re-growing due to recovering of foreign business. In this business field, sales of semiconductors amount to about \$5,600 billion and it occupies 15.8% of total sale 1993.

(2) Present Situation of Semiconductor Business

In the domestic semiconductor business Hitachi is placed 3rd position after NEC and Toshiba. In the field of MOS-memory, however, the company stands first and has a 12.4% world market share. And the company stands 7th in the field of Logic IC, and 4th in MPU. It occupies 7.4% of world market share including all kinds of semiconductors.

This business structure, where MOS-memory is the main business, has continued since the early 1980s when Hitachi was number one in the field of 256K DRAM. Technological accumulation of DRAM technology as “Technology Driver” created the current strength of the company based on the advantage of manufacturing technology.

On the other hand, in the case of MPU business Hitachi started in 1975 under the contract of second source supply to Motorola Inc. Since then, Hitachi and Motorola have maintained their relation for over ten years. However, Hitachi produces RISC for workstations as a member of a Hewlett-Pakard standardization group at present. Also as a member of an IBM group, Hitachi makes IBM compatible personal computers with Power PC.

In the field of flash memory which is expected to be a main product in next generation semiconductors, Hitachi tries to build a new standardization group with Mitsubishi and SGS–Thomson of France.

(3) Strategy of Alliances in 1970s and 80s

Hitachi could build alliances with a lot of global companies by making its manufacturing technology advanced and by utilizing it as the company's strength. By that means Hitachi has been growing in the semiconductor business. In this way, we can say that Hitachi's success in this business field is based on alliances.

Full-scale of semiconductor production by Hitachi was started in 1975 based on the second source agreement on MPU with Motorola. This was an indispensable process for Hitachi's technological development, because it enabled the company to accumulate its manufacturing technologies during its relation with Motorola, which continued for over ten years. Thereby Hitachi had the first position in the 256K DRAM field during this period.

After 1985, the strategy of semiconductor business of Hitachi has been changing. With the technological development of Hitachi, its dependency on Motorola diminished and their balance of power became on even ground. In 1986 their relation expanded to include joint development of 16 bit MPU, in which both of them were equal partners.

It those days, Hitachi began to make alliances with other foreign companies. For example, the company gained a license to production and sales of CMOS Logic IC from Fairchild in 1986, and tied up with VLSI concerning OEM supply of customized IC in 1987. After this, the company built an alliance with TI concerning joint development of 16M DRAM in 1988 and supplied SRAM for TI according to an OEM agreement in 1989.

Like this, from the end of 1980s to the early 1990s Hitachi entered into coop-

Table 3-1 Major Alliances of Hitachi (1985-1989)³⁾

Partners	Year	Content (Press Release)
Motorola	1985	MPU Second Source and Joint Development of 16 bit CMOS MPU
Thomson	1985	Mutual Exchange of License of Production
Fairchild	1986	License for Production and sales of Logic IC
VLSI	1987	Production of Customized IC
Fairchild	1987	Second Source of Logic IC
VLSI	1988	Technology Exchange on ASIC
TI	1988	Joint Development for 16M DRAM
VLSI	1989	OEM Supply of SRAM
TI	1989	Mutual OEM of SRAM

eration with a lot of the foreign companies in various fields of the semiconductor business, in order to gain international competitive advantages.

(4) New Phase of Strategic Alliances

In the 1990s the semiconductor business faces a huge transition of the business environment like multi-media, down-sizing and networking. With this transition, the position of DRAM as a technology driver is losing ground, and instead MPU is getting more important. The links between semiconductors as components and final products getting much stronger, as we can see for example in personal computers. The vertical relations with both software and hardware sides influence the whole semiconductor business more than ever.

Therefore Hitachi, just as other Japanese manufactures, which do not have MPU technology and is behind other foreign companies on the software technology, must build alliances with foreign companies which try to proceed the global standardization strategy (including defacto standard).

3) Data collected from Nikkei Database

In such a turbulent situation, Hitachi selected Hewlett–Pakard (HP) as a partner to introduce RISC type MPU technology. Their relation has continued since 1982 and now they know each other well. In this way, this alliances can be said to have advanced from a one–way relation to a two–way one. At present, however, Hitachi cooperation in the field of RISC is not restricted to only HP. Hitachi tied up with Sun Microsystems to collaborate in the production of RISC, the latter is competing with HP in the workstation business. Consequently, Hitachis alliances on RISC became more complicated. And at the same time the number of alliances with US small venture business (VB) which have advanced software technologies, are increasing recently. These relationships between Hitachi and these VB are complementary, that is to say Hitachi is getting advanced technology and VB are getting money and production technology.

Furthermore, the early 1990s is a turning point for semiconductor industry

Table 3–2 Major Alliances of Hitachi (1989 – 1994)⁴⁾

Major Partner	Year	Content (Press Release)
Kinsei (LG)	1989	Technology Transfer of 1M DRAM
HP	1990	Joint Development for RISC
Kinsei (LG)	1991	Technology Transfer of 4M DRAM
TI	1991	Joint Development of 64M DRAM
Ramtron	1992	Technology Transfer for FRAM from Ramtron
NMBS	1992	Technology Transfer for DRAM
Compas Design	1993	Software Design Technology with VLSI
Sun Micro	1993	Production of SPARC
LG	1993	Technology Transfer of 16M DRAM
Mitsubishi	1994	Joint Development of Flash Memory
IBM	1994	Supply RISC (Power PC)

4) Data collected from Nikkei Database

around the world.

The laws like four times larger the every three years and Silicon Cycle have become irregular. And the scale of investments in equipment and R&D is becoming huge in order to cope with large sizing of DRAM. However, most Japanese companies is shrank their investments because of the economic recession in Japan. Such situation has driven Japanese semiconductor manufacturers into alliances with large foreign competitors. That is to say, large-sized investments and the economic recession promoted alliances among large companies. A joint venture established with TI in 1995 is a typical case for Hitachi. In this project, the capital fund \$15 billion will be financed not only by both companies but also by other companies such as suppliers, banks and customers. The joint venture will construct a \$500 million plant for 16M DRAM and 64M DRAM in USA.

Another feature of Hitachis alliances in recent years is a closer relation with a Korean company, LG. Hitachi supplied 1M DRAM technology in 1989 and 4M DRAM technology in 1991 to LG. Hitachi seemed to have been a pioneer who proceeded to enter into corporation with a Korean company in those days and now their relation becomes much stronger. Hitachi gets 1– 4 million 4M DRAMs from LG, thanks to agreement according to which the latter should to supply half its amount of production to Hitachi. Also they tied up regarding the technological supply of 16M DRAM. In the future, Hitachi will get the same amount 16M DRAMs from LG.

On the other hand, Hitachi entered into corporation with a Japanese competitor, Mitsubishi, with respect to flash memory as mentioned at the beginning of this section. Flash memory will be a key product in the near future if it is standardized. In this way this alliance is a new step for both companies, though alliances between large Japanese companies has been taboo in Japan so far. Anyway the intense to dominate the world market by Hitachi and Mitsubishi might make the in-

ter-firm relations and competitive situation more complex.

4. Analysis

In the early 1990s semiconductor market became divided into two types. ; one is the commodity type of semiconductors such as DRAM and DISCREET, the other is MPU which has scarcity value technologically. Though the latter type keeps high and stable profit, most Japanese manufacturers depend on the former type that cannot maintain high profit. In such a context, Japanese companies have increased alliances with foreign companies more than ever, as mentioned before. Moreover patterns are changing.

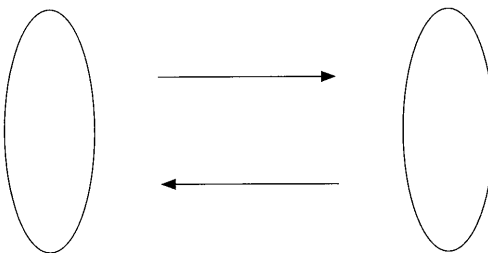
(1) Transitions of Alliance Patterns

According to our case studies strategic alliances can be divided into three phases. They can be called (1)Single-front Line Alliance, (2)Multi-front Lines Alliance, (3)Multi-dimensional Alliance.

a. Single-front Line Alliance

The first stage lasted from the late 1970s to the early 1980s. In this period, most of Japanese manufacturers had technologies that were less advanced than those of the US or European companies in this period. Then, Japanese manufactures tried to gain their own international competitive edge in the focused business

Figure 4-1 Single-front Line Alliance

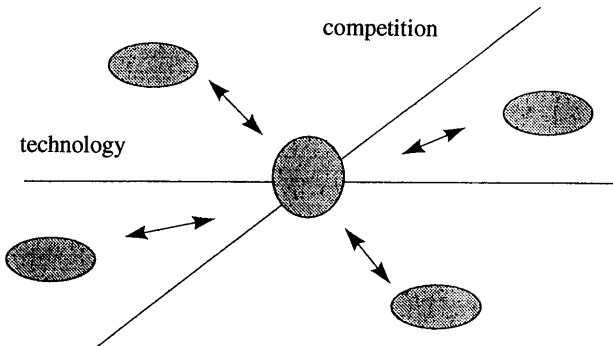


field. Therefore each of them entered into an alliance with a specific foreign company and deepened the relationship. This type can be called Single-front Line Alliance¹⁾.

b. Multi-front Lines Alliance

The second stage lasted from the mid-1980s to the early 1990s. In this period Japanese manufacturers advanced their technologies by leaps and bounds. They could get rid of the one-way dependence on US or European companies by building complementary relationships. There were various types of alliances like technological supply, OEM production, joint development and so on. Moreover each company had to ally with different companies depending on the situations, because their products or markets became diverse, changeable and complex. Thus Japanese companies had to cope with complicated situations in which they fought or allied with many other companies. This can be called Multi-front Lines Alliance²⁾.

Figure 4-2 Multi-front Line Alliance

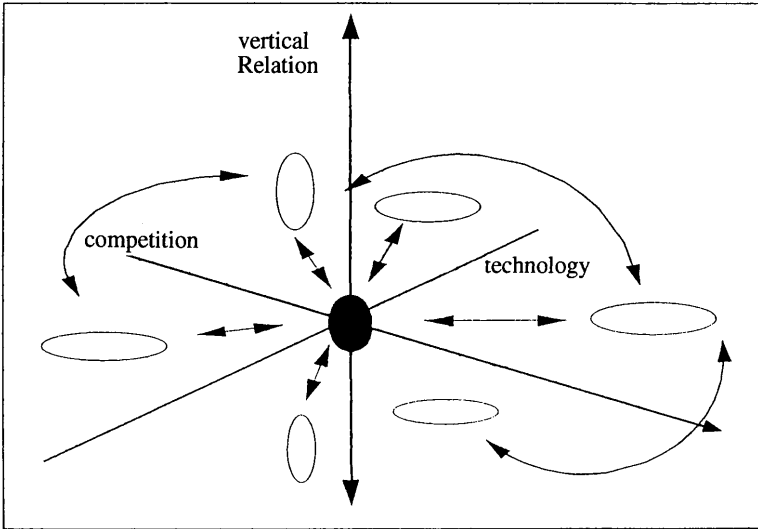


c. Multi-dimensional Alliance

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- 1) See 'New Era of Strategic Alliance', *Grand Strategy*, Teramoto et. al.(1993), Japan Management Association Management Center, Tokyo.
 - 2) *ibid.*

The third stage started from the mid 1990s, when semiconductor industry are confronted with unprecedented environmental changes. We can point out the features of the transitions of recent semiconductor business as following.

Figure 4-3 Multi-dimensional Alliance



Partners of Alliances

The first feature is that the partners are not restricted to American or European firms. Until 1990s, the partners of Japanese semiconductor manufacturers were only American or European companies regardless of the size of these companies. Not only in the period from 1970s to early 1980s, when US companies technologically overwhelmed Japanese, but even in the late 1980s when Japanese companies had already become competitive, the partners of Japanese companies were American or European firms.

However since 1993, the number of Japanese-Korean alliances is increasing. One of the reasons is that the demand for DRAM is rapidly increasing, due to the

recover of computer market in the US. And the other reason is that the product life cycle of semiconductor reaches the period of maturity. Under such conditions, Japanese and Korean semiconductor suppliers intend to avoid price competition through these alliances.

Besides these Japanese–Korean alliances, we can since recently observe a trend toward Japanese–Japanese alliances. The main purposes of the alliances with US and European companies were to share resources and reduce R&D cost. In the case of alliances among Japanese companies, however, the partners want to build a market leader group through realizing the technological standardization. Therefore, these alliances may be seen as more strategic natures.

Alliances with VB

A second feature is that the number of alliances with venture businesses is increasing. The alliances among Japanese large companies and with US venture businesses are very common, though we can not find many articles about them in the database.

Production of advanced semiconductors requires high–level manufacturing technologies and a lot of investment, even if small VB has sophisticated design technologies. That is why they cannot produce such semiconductors by themselves. Manufacturing MPU and ASIC requires rather advanced process technology, though MPU and ASIC did not need as high–level manufacturing technologies as DRAM in the past. In fact, Intel’s process technology attains the highest level in the world, and this company invests in equipment and R&D not less than Japanese manufacturers. The era, when companies could become competitive based only on design technology has passed. Therefore VB being short of money are positively trying to approach Japanese companies.

Moreover, as each final product requires the development of semiconductors suitable for it, the variety of semiconductors is increasing. This is also the reason

why the number of alliances with VB is increasing.

Vertical Alliances

The third feature is that vertical alliances with downstream or upstream companies are increasing adding to horizontal alliances. Relations between semiconductor manufacturers and set maker, the makers of final product were mainly customers-suppliers relations based on their trade, but now these become much closer. They include inter-firm development collaboration called "design-in". Some researchers have pointed out that this was the strength of Japanese manufacturers whose business were comprehensive³⁾.

Currently the number of a new type of collaboration called "concept-in" is increasing. It means that companies in partnership collaborate from the phase of concept making of products. In short, the relationships evolve from supplier-customer to cross-industry relationship, in other words, the deepening of vertical relationship. Such a transition of inter-firm relationship can be seen in the relations with software companies. Thus, alliances with companies in upstream, downstream or different industries become an indispensable strategy for survival in the semiconductor business.

In short, alliances have evolved from Multi-front Lines Alliance to Multi-dimensional Alliance.

5. In Conclusion

However such environmental changes are not only risk but chance for companies. Semiconductors which have continuously advanced will not stop their progress. Flash memories, FRAM, and/or other special semiconductors after DRAM and MPU will appear and become major products in near future.

3) See 'The Core Competence of the Corporation', *Strategy*, Prahalad C. K., and G. Hamel (1989), HBS Press, Boston.

Under such conditions, Japanese companies have a chance to recover a top position in semiconductor business through new types of strategic alliances.

The first point is to recognize that inter-firm relations are continuously evolving. The inter-firm relations influence each other and change themselves. The more complicated technologies become, the lower the borders among industries or companies will be. Sometimes they may change the whole industry. If Japanese companies do not consider their inter-firm relations from the view of their present business domain based on horizontal inter-firm relations, but if they try to consider from the multi-dimensional views to fuse other business into their business domain, they may be able to expand their chances to create a new business or a new industry in the future. At that time, it may become an advantage for Japanese semiconductor manufacturers as comprehensive electronics companies.

The second point is to understand multi dimensional relations and to interpret them in content of the vision and strategy of corporation as a whole. When the company change or rearrange inter-firm relations with partners or competitors in the turbulent environment, some contradictions might be brought about in individual relations. If each relation is not linked with corporate vision and strategy, it might lead to a long-term disadvantage. The weight of each relation in the multi-dimensional alliances is lower than in the single-front line alliance. As a result, it becomes very important to keep total balance of multi-dimensional alliances as a whole.

In summing up, how to manage the multi-dimensional relationships is a key factor of success for Japanese semiconductor manufacturers.

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