



Asahi Glass Company: Diversification Strategy

Asahi Glass Company (Asahi Glass), founded in 1907, was the oldest and largest glass manufacturer in Japan and a prominent member of the prestigious Mitsubishi Group. After establishing a leading position in the domestic glass industry, the company gradually expanded its range of businesses and its geographic scope through internal growth, acquisitions, and joint ventures. By 1992, Asahi Glass had become a multibusiness, multinational company with consolidated sales exceeding ¥1.3 trillion (\$10.5 billion), of which 23% were outside Japan (**Exhibit 1**).

President Hiromichi Seya and other top management of Asahi Glass believed that the company was at a critical juncture in 1993. Adversely affected by Japan's recession, the company's sales had leveled off and net income had dropped in the previous three years. More fundamentally, the company faced a number of vital issues. Its original domestic glass business had matured, while the rapid globalization of its activities into Europe and North America challenged its management practices. The company's diversification into electronics-related business had not met expectations. In the meantime, other opportunities such as "new glass" were appearing on the horizon. In order to continue its pattern of profitable growth into the twenty-first century, top management had to plan Asahi Glass's future diversification path carefully.

Company History

From Start-up to World War II

Asahi Glass Company was established by Toshiya Iwasaki, a former chemistry student and nephew of the founder of the Mitsubishi business group (**Exhibit 2**). Strongly committed to contributing to Japan's industrial success, Iwasaki set himself the goal of establishing a domestic flat (or sheet) glass industry in order to reduce Japan's reliance on imports. Although others, including the government, had failed to manufacture glass commercially, Iwasaki's "pioneer spirit" and "mission to succeed" took on the challenge, and left a lasting legacy in the corporate culture. Having imported the technology, skilled craftsmen and raw materials from Belgium, Asahi began sheet glass production in 1909. It became Japan's first successful sheet glass manufacturer when in 1912 it made its first profit—a feat not replicated by a competitor until 1920, when a startup by the Sumitomo group succeeded in the mass production of sheet glass, licensing technology from America. Asahi Glass thus established a dominant position in the domestic market.

Doctoral Candidate Tomo Noda prepared this case under the supervision of Professor David J. Collis as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

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Because Japan's economy was still in its infancy, Asahi Glass relied heavily on European soda ash and refractory bricks. When difficulties importing these raw materials arose during the First World War, Asahi Glass began making them in-house. The company later began selling refractory bricks and soda ash to other high-heat furnace users such as steel and cement producers and to chemical companies, respectively. Later, in order to exploit scope economies in raw material usage, Asahi Glass began using raw salt to produce caustic soda (an alkali) in addition to soda ash (**Exhibit 3**). Therefore, although the vast majority of its revenue still came from glass, Asahi Glass developed technological expertise in ceramics and alkali chemicals.

From World War II to the Oil Crises

As the Japanese economy recovered following World War II and then grew rapidly during the 1950s and 1960s, demand for glass and other construction materials exploded. Since Asahi Glass' three domestic glass plants had survived the war, the company was well-positioned to exploit the boom in demand. Indeed the major strategic problem during this period was ensuring that the factories could produce sufficient volume of high quality output to meet demand. The rapid growth of the market attracted a new entrant, supported by the Mitsui group, in 1958. A triopoly then emerged in the domestic flat glass market, with Asahi Glass as the leader.

Flat glass technology changed dramatically in the late 1950s when Pilkington Brothers, a major U.K. glass manufacturer, invented the float glass process. This revolutionary technology involved floating molten glass over the surface of molten tin, and annealing it into a strip of sheet glass. Gravity, acting on the upper surfaces of both the tin and the glass, ensured that both sides of the sheet were perfectly flat (**Exhibit 4**). Because of its technological superiority, all the major glass manufacturers in the world, including Asahi Glass, licensed the float process from Pilkington to preserve their market positions.

The fast-growing television set and automobile industries also boosted postwar demand for glass in Japan. Licensing technologies from Corning Glass Works, Asahi Glass started the production of TV glass bulbs in 1954. It then entered the fabricated automobile (safety) glass business in 1956 drawing on its own technological expertise. By the end of the 1960s, Asahi Glass established the leading domestic position in these two markets.

In the meantime, searching for additional high volume opportunities, the company entered into other glass-related businesses. It relied on a Japanese engineer who was sent to live in the United States to gather information. In 1956, it set up a joint venture with Owens-Corning Fiber Glass Corp. to start the production of glass fiber in Japan. In 1964, the company strengthened its borosilicate-glass business (for automobile headlight glass, laboratory ware, and heat-resistant, glass houseware) by inviting the equity participation of Corning Glass Works in its subsidiary, Iwaki Glass, in return for Corning's technology.

Asahi Glass also entered the construction materials business. The company already had a strong brand identity within the construction industry, and its wholesalers dealt directly with many builders. Licensing technology from a Swedish firm, Asahi Glass began producing and marketing ALC (autoclaved lightweight cement) in Japan in 1962. In 1973, it started the production of GRC (glass reinforced cement) with technology licensed from Pilkington Brothers.

Like its glass business, Asahi Glass' chemical business rapidly added new products and markets after the war. Because of the existence within the Mitsubishi group of Mitsubishi Kasei, which produced organic chemicals, Asahi Glass initially stuck to alkali and other inorganic chemicals. When a petrochemical industry emerged in Japan in the late 1950s, the company also eschewed becoming a producer of basic petrochemicals such as ethylene and propylene to avoid competition with Mitsubishi Petrochemical. Instead, Asahi Glass focused on alkalis and halogen elements (fluorine, chlorine, bromine, and iodine) as well as their petrochemical additives.

After WWII, Asahi Glass began producing caustic soda using a mercury electrode to perform electrolysis on salt water. Electrolysis not only produced very pure caustic soda, it also yielded chlorine as a by-product (**Exhibit 3**). Combining chlorine with basic petrochemicals, Asahi Glass started the production of propylene oxide and propylene glycol in 1961, and then established a joint venture with PPG Industries to produce vinyl chloride monomers and chlorinated solvents in 1966. Combining chlorine with natural gas (methane) available near its caustic soda factory, Asahi Glass also began producing chloromethane, which was then used to move into the production of higher value-added chlorofluorocarbons (CFCs). Having developed new applications and new markets for its products, Asahi Glass became a leader in a number of specialty product markets, and secured a unique position in the domestic chemical industry.

Throughout this period, Asahi Glass set growth as its primary objective. Top management allowed the divisions to explore new product and geographic market opportunities on the basis of their technological expertise, without obligation to adhere to a given strategic direction.

From the Oil Crises through the Early 1990s

By the early 1970s, Asahi Glass' glass and construction materials business accounted for more than 50% of total revenue, and the chemical business for about 40%. Although revenue growth had fallen short of management's expectations, profits, which mostly came from the company's leading position in the domestic flat glass market and several niche chemical markets, averaged three times those of the Japanese manufacturing industry.

The two oil crises in the 1970s, however, cast a shadow on the future of the company. As the Japanese economy shifted into a more modest expansion phase, the growth of its basic materials businesses slowed (**Exhibit 5**). Concerned about this trend, then-president Takeo Sakabe decided in the mid 1970s to begin building an electronics business as the company's "fourth pillar"—following glass, chemicals and ceramics.

Sakabe focused on electronics because of its growth potential and also because his management had some expertise in it. The company's first foray into the electronics business had been in the mid 1960s, when it formed a relationship with a subsidiary of Corning Glass Works to import and market integrated circuits (ICs). Even after Corning divested its semiconductor business, Asahi Glass continued to distribute ICs, finding new suppliers such as National Semiconductor and Oki Electric. Asahi Glass's other involvement with electronics was through its development of glass delay lines—electronic elements that improved TV picture quality by letting ultra-sound signals conduct through glass with some time lag in order to complement video signals. At the request of TV set manufacturers, Asahi Glass's TV glass bulb researchers started research on glass delay lines in 1970 and successfully developed its own technology in 1974.

Top management set a goal of developing electronics to generate 10% of the company's revenue within 10 years. They decided to focus resources on areas such as displays, optoelectronics and components for ICs, where they judged Asahi Glass had the relevant raw materials expertise or processing/fabricating knowledge. Among these areas, management particularly emphasized the development of liquid crystal displays (LCDs),¹ partly as a hedge against the substitution of LCDs for the TV glass bulb business. The company's research group began exploring LCD technology in 1970, and then participated in a cooperative research project sponsored by the Ministry of International Trade and Industry (MITI). Empowered by top management's strategic decision, research was scaled up and led to the formation of a joint venture called Optrex in 1976, in which Asahi Glass owned 60% and Mitsubishi Electric 40%, to commercialize small-sized LCDs used as the displays in products

¹LCDs were made up of liquid crystals sandwiched between two glass substrates. The liquid crystals received a charge from an electronic driver to generate the display.

such as electronic calculators, digital wrist-watches, and automotive panels. Optrex soon became Japan's second largest manufacturer of LCDs, primarily supplying automobile manufacturers.

The Electronics Business Division was established as an independent division in 1982, and was later upgraded to a general division in 1989. In 1984, the company acquired controlling interests in Nippon Carbide Industries Co., and ELNA Co. Nippon Carbide's ceramics processing technology and ELNA's circuit board and aluminum capacitor technology were important for understanding electronics production, although ELNA in particular came with other businesses not necessarily appropriate for Asahi Glass. In addition, by hiring about 50 electrical engineers from the outside, the company established the Electronics Product Development Center at its Central Laboratory in 1985. Since acquisitions and head-hunting were uncommon in Japan, these aggressive moves attracted public attention to the company.

In 1987, Asahi Glass decided to expand its involvement in electronics. In response to an inquiry initiated by Komag Inc., a recently established manufacturer of thin-film disks in California, the company formed a joint venture. Asahi-Komag produced and marketed sputtered thin-film magnetic memory (hard) disks in Japan. Asahi Glass judged that its surface treatment expertise, developed in the glass business, could be applied to the production of disks. Also, it anticipated that glass instead of aluminum would be used as the base material for disks in the future. The joint venture contract was highly detailed in its treatment of technical issues. Small innovations were to be shared freely, "epoch-making" breakthroughs would be cross licensed, and both parties agreed to limitations on their activities if the venture dissolved. The first shipment from the new factory was made in 1987.

The company's quest for growth was not limited to electronics. In 1981, a new business division was established to develop the optical lens business. While Asahi Glass had been an OEM supplier of glass lenses, it decided to become a full-line provider of optical frames, glass and plastic lenses.

While seeking growth by entering these new businesses, Asahi Glass also attempted to strengthen its three traditional businesses by shifting from commodity products to specialty, value-added products. In order to strengthen its position as supplier of materials, the company also expanded into the selected areas of "processing" and "assembling" even though such downstream moves sometimes put the company in competition with its own customers.

In the glass and construction materials business, the company further enhanced the design, safety, and energy conservation qualities of its materials, and developed a number of new products including heat-reflective glass and high-insulating double-glazing glass units. In its chemical business, Asahi Glass developed a variety of specialty chemical products, such as foam urethane products for automobile bumpers and seats, fluorinated etching gases used in semiconductor fabrication, and fluoropolymer resins for weather resistant external paints.

Asahi Glass also maintained its lead in the domestic alkali chemical business by developing an ion-exchange membrane production process for caustic soda in 1975. The need for this arose when the government prohibited the use of the "mercury process" for caustic soda production after the "Minamata" mercury-poisoning disaster in 1973. Up to 100 engineers were committed to the development project, which combined Asahi Glass's skills in caustic soda production, fluorinated resins as a material for the membrane, and membrane technology itself to commercialize this state-of-the-art process technology. Later, the company applied the ion-exchange membrane technology to develop a hollow fiber membrane for dehumidifiers and hydrogen fuel cells.

The refractories business also evolved into a broader-scope ceramics business. Initially, Asahi Glass explored the possibility of developing temperature-, corrosion-, and wear-resistant ceramics for structural components such as car engines, heat exchangers, and radiators. It established a new division in 1982 to further promote such "structural" ceramics. Later, when a large market for

structural ceramics that could be demanded in large quantities failed to emerge, Asahi Glass switched to develop the “functional ceramics” that Kyocera had pioneered. Such functional products were made from fine ceramic compounds according to precise specifications, primarily for use in electronics.

Globalization

After losing its first overseas glass and soda ash plants in China as a result of WWII, Asahi Glass resumed foreign direct investment in 1956. The company accepted the invitation of the Indian government to build a local sheet glass plant primarily to supply the Indian market. It then established a flat-glass joint venture with local partners in Thailand in 1964 and in Indonesia in 1972. Both these plants focused on Southeast Asian markets, which were beyond the region of interest to the Western glass companies and protected by local governments. Asahi Glass’s policy was to “co-exist” and “co-prosper” with these economies by developing their infant industry, substituting domestic production for imports, and creating employment. While Asahi Glass would send between five and ten Japanese employees to these affiliated plants to provide technical and marketing know-how along with financial support, it delegated all the daily operations to local managers and relied on its local partners for distribution.

Because of economies of scale in float glass production, by the late sixties, the world glass industry was dominated by a few giants, especially Pilkington in the U.K., Saint-Gobain and BSN in France, and PPG in the United States. The increasing automation of the float glass process made it possible for them to operate glass plants without highly skilled labor, so while these firms first entered neighboring regions through exports, increasingly they made foreign direct investments—the Europeans in Africa, Middle East and Latin America, the Americans in Central America—each establishing their own spheres of influence.

This equilibrium was disturbed in the early 1980s when BSN-Gervais Danone, a French conglomerate, decided to exit the glass business and divest its four unprofitable glass subsidiaries in France, Belgium, Netherlands, and Germany. Because of antitrust regulation, the Continental European glass manufacturers could not bid for the BSN plants. Instead, Pilkington purchased the German subsidiary, PPG purchased the French subsidiary, and Asahi Glass bought the Belgian (Glaverbel) and Dutch (MaasGlas) subsidiaries. Asahi Glass wanted to acquire the companies in order to learn the European market, access European R&D, and develop the African market. As with its other overseas operations, Asahi Glass retained the management of Glaverbel and MaasGlas and delegated most management decisions to them.

The company’s automobile safety glass and TV glass bulb operations also globalized during the 1970s and 1980s as the Japanese automobile and consumer electronics manufacturers started transferring their production facilities, first to Asian countries and then later to the United States and Europe. Following the moves of its customers, Asahi Glass built overseas operations for TV glass bulbs in Singapore in 1979 and in Taiwan in 1980. In the U.S. market, it formed a joint venture with Corning Glass Works that took over the operation of Corning’s TV glass bulb facilities in 1988. It also started fabricated automotive glass plants both in Thailand and Indonesia in 1974, and in the United States in 1985.

Similarly, Asahi Glass’ chemical business pursued its own globalization strategy. The company started the production of caustic soda and chlorine first in Thailand in 1965. Later in 1989, it established an integrated operations for caustic soda, chloro vinyl monomers and polymers in Indonesia. Then in 1990, it formed a joint venture with Tenneco Minerals in the United States, its first chemical activity outside Asia, to mine natural soda ash for supply to its local glass plants as well as to outside customers.

Businesses in 1992

In 1992, 56% of Asahi Glass's sales came from glass and related products, 30% from chemicals, 6% from electronics, 2% from ceramics and refractories, and the remainder from other areas (**Exhibits 6** and **Exhibit 7**).

Glass and Related Products

Three general divisions were responsible for Asahi Glass's glass and related businesses—including architectural glass for buildings, glass reinforced cement (GRC) and other construction materials, fabricated glass products for automobiles, and TV glass bulbs. Asahi Glass was not active in fiberoptic cable because in Japan the telecommunication and copper wire companies had won Corning licenses. Nor was Asahi Glass a manufacturer of specialty glass (like Corningware), except through its ownership of Iwaki Glass, because the company had historically sought high-volume industrial markets rather than small consumer markets.

Flat glass was the company's biggest generator of sales, and especially of profits. In Japan, Asahi Glass was the dominant supplier with about a 50% market share, followed by Nippon Sheet Glass and Central Glass, who held 30% and 20% of the market respectively (**Exhibit 8**). Nippon Sheet, specialized in glass and construction materials business, and was putting a new emphasis on fiberoptics. Central Glass, the newest of the three competitors, operated alkali and other chemical businesses as well as glass production. The market shares of these companies had remained virtually unchanged since the mid 1960s.

Flat glass was almost exclusively made through the float process. The glass was then transported to wholesalers and dealers who stored, cut, and merchandised the glass directly to customers. In Japan, there were over 400 small-sized, independent wholesalers. Historically, these wholesalers had received financial and technical support from one of the three big manufacturers, and had developed a one-to-one relationship to deal only with that manufacturer. Such relationships were also seen in Europe, but were not common in the North American markets. Unlike wholesalers, most of the dealers did not have an exclusive relationship with a particular glass manufacturer and could buy from any manufacturer. Sixty percent of Japanese domestic flat glass production went into construction, 30% to automobiles and 10% to other industrial uses such as mirrors, display cases and furniture.

Worldwide, Asahi Glass competed with European and American rivals (**Exhibit 9**). Pilkington Brothers was a 100-year-old British glass manufacturer which had invented the epoch-making float process technology. In addition to its core glass business which generated 80% of its sales, it had diversified into ophthalmics (spectacle lenses, contact lenses, and lens care systems) and insulation materials. For many years, license fees from its float glass process had provided Pilkington with a substantial cash flow. However, the key patents expired in the mid 1980s, and Pilkington's license fees were correspondingly reduced. Saint-Gobain, a French conglomerate, started operations in the seventeenth century as the royal glassmaker to Louis XIV. About 20% of the company's sales were in flat glass and the rest were spread evenly among industrial ceramics, containers, insulation, paper-wood, pipe, and related materials. PPG Industries, established in 1883, was also a major paints and chemical producer. In 1992, its three major businesses—glass, paints and coatings, and industrial and specialty chemicals respectively generated 40%, 40%, and 20% of its total sales. Guardian Industries, the world fifth largest glass manufacturer, was a relatively small but fast-growing newcomer, known as a low-cost and aggressive competitor. It had lobbied to include the Japanese domestic sheet glass market in the structural impediments to trade debate between the U.S. and Japanese governments. While some foreign companies, such as PPG Industries, steadily penetrated the Japanese market with local marketing efforts, Guardian argued that the exclusive distribution networks functioned as an effective nontariff barrier.

With a few exceptions, competition in the glass business was seen as friendly but fair. The inherent limitations on transporting flat glass restricted import competition, and the large minimum efficient scale of a float glass plant and the need for distribution usually prevented competitors building plants in each other's major markets. The scale requirement also limited foreign direct investment to one plant per country in developing areas. As the economies of these developing countries expanded, however, it gradually became possible to justify a second plant. For example, Guardian entered into Thailand by building the country's second float glass plant in 1992. In India, Guardian also began to compete with Asahi Glass with its own float glass plant.

Asahi Glass's construction materials business produced wall, ceiling and floor materials made of glass, cement, ceramics and composites. In the early 1990s, the demand for its GRC (glass reinforced cement) fireproof siding boards surged despite the recession in Japan, and Asahi Glass was expanding the production of the material. In addition to selling construction materials, Asahi Glass was also developing systems technologies for construction.

Fabricated glass involved the additional processing and/or fabricating of flat glass in order to improve safety in products such as automobile windshields. The major flat glass manufacturers were also key players in this market, which had become increasingly global. In 1992, Asahi Glass had a 56% market share in the domestic market and a 20% world market share.

Glass bulbs for cathode-ray-tubes (CRTs) were manufactured in large-scale, specialized plants where molten glass was precision molded, polished and finished. As unique operational know-how and close coordination with TV set manufacturers was required, only a few major manufacturers of TV glass bulbs remained. Asahi Glass was the market leader with an exceptional quality control record and distinguished technology. It shared the domestic market equally with Nippon Electronic Glass, an affiliate of NEC (**Exhibit 8**). It held about a 30% global market share, leading competitors such as N. V. Philips in the Netherlands, Schott in Germany, and a joint venture between Samsung (in Korea) and Corning which covered Southeast Asia. Asahi Glass centrally coordinated the production and distribution of glass bulbs to Japanese and foreign TV set manufacturers from its two domestic and four overseas factories.

Chemicals

Asahi Glass's chemical businesses were handled by the five divisions of the Chemical General Division. The ratio of specialty and fine chemicals to the company's chemical business had steadily increased since the 1970s. The company also sold its chemical engineering expertise, providing, for example, membrane and electrolysis technology and technical assistance to other manufacturers. The bulk of its sales remained in the domestic market for its own use and to other Japanese chemical and manufacturing companies.

Alkali products still constituted the major portion of Asahi Glass's chemical business in 1992 although their relative importance had been gradually declining. As a major consumer itself, Asahi Glass produced 40% of the soda ash made in Japan, and was also engaged in the joint venture with Tenneco in the United States. It was also the largest domestic producer of caustic soda with a 46% market share using its efficient, environmentally-safe ion-exchange membrane process technology to supply pharmaceuticals, synthetic fiber, and paper and pulp manufacturers. In its commodity chlorine business, including inorganic and organic chlorine derivatives, the company had secured a stable position as the treatment of chlorine required specialized know-how and new entry was difficult. However, chlorinated solvents such as trichloroethylene were suspected of causing health problems, making the future potential of this line of business uncertain. Similarly, although the company was a top producer of fluorochemical products, its chlorofluoro carbons (CFCs), widely used as coolants for refrigerators and air-conditioners, were suspected of destroying the earth's ozone-layer. As a result, and in accordance with international regulations based on the Montreal Protocol, the company was reducing production of CFCs and investigating environmentally-safe

alternatives. At the same time, it was allocating resources to develop more value-added products such as fluorinated/fluoropolymer resins, rubbers and films, and pharmaceutical and agricultural intermediates.

Ceramics and Refractories

In 1992, Asahi Glass's Ceramics and Refractory Division offered the capability to provide turnkey high heat furnaces to industries such as steel, including the design of the furnaces, supply of refractory products themselves and the construction of the furnace. The Fine Ceramics Division, which was renamed from Engineering Ceramics in 1988, developed and marketed structural and functional ceramics but remained small relative to Kyocera.

Electronics and Other Businesses

The Electronics General Division supervised and coordinated the company's electronics business activities including those of the company's relevant subsidiaries and joint ventures such as Optrex, ELNA, Nippon Carbide, and Asahi-Komag. Its major products were IC-related components, glass delay lines, LCD panels and memory disks, and the majority of these products were sold domestically (**Exhibit 10**). Optrex, Asahi Glass's LCD joint venture, was increasing production rapidly and was strongly positioned in the market, particularly for automotive LCD panels, although major R&D capital expenditures were required. TFT active matrix LCD research, for example, had cost \$70 million per annum, and a new \$200 million facility would soon be built. Asahi-Komag's thin-film magnetic memory (hard) disks were also well accepted in the market because of their superior recording density.

Other divisions included Optical Products which produced and marketed glass lenses and plastic lenses with fluorine-based non-reflective coatings as well as frames under its own brand name. The Specialty Products Division also sold a number of unique home, health and medical products. To date the division had developed products such as a face washer based on the company's ultrasonic technology, and hot bath-water purifiers that used the ion exchange membrane technology. Other products included an egg timer, infrared sauna and a self-cleaning toilet. The division also produced fiber-reinforced plastic (FRP) for precision plastic parts, and marketed them to office automation equipment manufacturers.

Organization Structure and Systems

Organization Structure

Asahi Glass had adopted a matrix-like organization structure (**Exhibit 7**). While physical production and selling activities took place in the factories and sales offices, general management and profit responsibility lay in the divisions which were in effect given their own balance sheets. As the number of divisions had been growing over time in line with the company's diversification, the company had consolidated 30 divisions into 18 divisions in 1979, and introduced general divisions, one for each of the major product areas, in 1985 to act as sector level coordinators supervising several functional divisions. In 1993, the company had six General Divisions and five independent Divisions.

Asahi Glass's product divisions were closely interrelated; many divisions supplied raw materials or end products to other divisions. Transfer prices were not employed between production and sales divisions within the same product division, but were used if product flowed across product divisions such as soda ash supplied by the Chemical to the Flat Glass General Division.

New business activities that were not obvious fits with existing divisions were concentrated in the Specialty Products Division. This had its roots in a “Corning Center” established in 1960 with the purpose of leveraging the company’s technology into consumer markets. Originally the company’s IC and LCD developments had been concentrated in this division before being moved out to the joint venture companies or the electronics division.

International activities were coordinated by the International General Division. Since all of Asahi Glass’ international subsidiaries were profit centers, and many of them were joint ventures in which Asahi owned only a minority share, the main role of the International Division was liaison between the overseas subsidiaries and the domestic product divisions. It monitored the performance of the overseas subsidiaries and affiliates; helped them in developing business strategies; provided analytic help for new plant decisions; and worked jointly with the divisions for new business development overseas. While Asahi Glass had about 200 Japanese employees overseas, nearly all were divisional personnel who remained assigned to their own division and not to the international division.

Since Asahi Glass was trying to localize its foreign activities, product divisions only exercised indirect influence on their overseas subsidiaries. While in many cases the company would have a minority Board membership and a few employees on assignment at the foreign subsidiaries, they would not dictate day-to-day activities, such as local pricing. Instead, subsidiaries sent monthly financial and operating reports for review, and needed approval only for major initiatives such as new plant investment or bond financing. For some of the major subsidiaries such as Glaverbel and AFG Industries, executive meetings were called once every three or four months for Asahi Glass’s management to discuss the important managerial issues. Otherwise relationships were conducted more informally between relevant personnel on topics such as technology transfer and product development. The exception was the TV bulb glass business. Because Asahi Glass viewed this as a global business, all the foreign subsidiaries, except the Corning joint venture in the United States, were majority-owned and directly controlled by the Product Division. This enabled production, distribution and pricing decisions to be globally optimized and worldwide performance to be evaluated on an ongoing basis.

R&D and New Product Development

R&D activities were handled by the R&D General Division’s research centers and by the Product Division’s research laboratories. Of the company’s 1,450 researchers, 700 were in the corporate research center, 200 in the separate Corporate Advanced Glass research center, and the remainder in product divisions. However, the Electronics Division laboratory was physically located at the corporate center. The Division intended to establish a laboratory on site with its other facilities “when it could afford it.”

Corporate R&D was responsible for basic research, the product divisions for new applications. Formal meetings between the two groups took place monthly with the general manager of a product division meeting the heads of the laboratories at the corporate center which were most relevant to his interests. About 70% of the corporate R&D expense was borne by the divisions which paid for specific R&D programs, and the remainder was allocated to divisions as a percentage of their sales.

In an attempt to facilitate the product development process and make the company more entrepreneurial, the Star Business General Division hosted “star leader” products. The division had been introduced in 1985, to promote intrapreneurship. Twenty products then under development or investigation were selected and assigned to a leader, usually a champion of the product. The leader was given corporate funding and the authority of a division general manager to accelerate a product’s commercialization by taking charge of the entire product development process from R&D through to manufacturing and sales. By 1993, two of those projects (i.e., weather-resistant fluoropolymer paints

and thin-film magnetic memory disks) had graduated back to the divisions when they reached ¥10 billion in sales, and six remained active. New projects were chosen from those proposed by the divisions according to their expected future potential size and profitability. Currently Asahi Glass was spending about ¥500 million every year on Star Leader projects, mostly on necessary capital investments.

Human Resource Management

Like other Japanese companies, Asahi Glass hired its future executives for life, and paid executives on a companywide scale that was independent of the business unit they worked for. The company ranked as one of the most desirable manufacturing companies to work for in Japan and recruited graduates from the country's most prestigious universities as well as some executives in their thirties via headhunters. After spending five years in one division, all nontechnical graduate hires would be transferred to a different division. After that, transfers between divisions were the exception rather than the rule, and each business developed its own culture. Senior management, however, tried to encourage cross-cultural transfers and promote a generalist perspective. Moves to subsidiary and joint venture companies also occurred. In 1992 Asahi Glass had 40 employees (mostly R&D personnel) at Asahi-Komag, 70 at Optrex and 10 at ELNA.

Planning and Resource Allocation

Since 1990 Asahi Glass had been operating under the "Vision 21" long term plan, whose theme was "Aiming to be a global corporation prospering in the twenty-first century." The vision saw the company "consolidating our business base further and maintaining expanded equilibrium of our business through harmony of expansion and stability." Objectives for the year 2000 were mainly financial, including targets for non-consolidated sales of two trillion yen (from one trillion in 1991), profits of 15% of sales (from 6%), R&D at 5.5% of sales (from 3%), and for 20% of sales to come from products introduced within the last five years. As a tool to measure the company's progress, Asahi Glass employed the concept of "weight value." The company believed it could achieve its objectives by moving into higher value-added businesses and raising the revenue per kilogram of output from ¥100 to ¥150 by the year 2002.

Below the long-term plan was a five year plan, revised every 2-3 years, that defined financial goals and resource allocation by division. The strategic planning group decided overall resource availability according to cash flow projections and acceptable debt levels. This was allocated among divisions according to how the company wanted the sales mix to evolve. The five year plan for 1987, for example, had anticipated electronics becoming 10% of corporate sales, and the division had accordingly been absorbing 15%-20% of the company's R&D in an attempt to reach that share of sales. The one year budget, revised every six months, was directly linked to these longer-term plans with divisional expenditures for capital and R&D in the budget expected to be set in line with the five-year plan.

Compared to other large Japanese companies, Asahi Glass was known for its top-down management style with a history of many important management decisions having been initiated by the top. The Senior Management Committee of the company (the top seven executives) met weekly to review important issues, monitor performance problems in the divisions as identified by the corporate strategic planning group, and approve capital requests over ¥1 billion.

Although top management and the corporate office provided general guidance, they typically did not dictate the strategy for each business. The rule was not to go too far from the core business, as corporate management did not want divisions to "parachute into new areas." President Seya—Asahi's first president to have come from neither a glass nor an engineering background—strongly believed that for each business unit to be viable it should be allowed to grow in its area of strength

and that middle management should take future oriented initiatives in order to encourage aggressiveness in the organization.

Issues Facing Asahi Glass in 1993

In the 1990s, Asahi Glass's performance was badly hurt by the sluggish Japanese economy. In particular, the domestic glass business expected sales and profits to decline for the third consecutive year in 1993.

Accelerated Globalization in Glass

The overseas expansion of the traditional flat glass business was an immediate growth solution for cash-rich Asahi Glass. As the "Iron Curtain" lifted and Eastern European governments started to privatize their glass operations, major global players rushed into this new market. Purchasing former government-owned glass plants and upgrading technologies, Saint-Gobain entered East Germany, Guardian Hungary, and Pilkington Poland. Asahi Glass's Glaverbel subsidiary moved into the former Czecho-Slovakia in 1991. The growth potential of Asian countries also attracted attention. Guardian built a float plant in Thailand, while Asahi Glass and PPG established a \$100 million joint venture in China in 1992.

In the meantime, Asahi Glass's presence in the North American market was enhanced in 1992 when Asahi Glass, jointly with Glaverbel, acquired AFG Industries. AFG was the second largest glass manufacturer in the United States with six float glass plants in United States and one in Canada. When AFG was bought out by its management in 1988, top management of Glaverbel, who had personally known AFG's management and been enthusiastic about the entry into the North American market, persuaded Asahi Glass to invest in the MBO. With PPG Industries and Pilkington's which already owned Libby-Owens-Ford, the second largest U.S. automotive glass manufacturer deterred by anti-trust regulation, Asahi Glass bid against Saint-Gobain to purchase a 20% share of AFG in 1988 with an option to buy the remaining 80% shares through 1993. After a heated internal discussion, Asahi Glass decided to exercise that option in June 1992, at a cost of about \$1.1 billion.

Such an accelerated globalization of the company, however, challenged Asahi Glass's traditional international practice. Notwithstanding its years of international experience, Asahi Glass was still developing its organizational capabilities outside of Asia. For several years, for example, it had experienced difficulties in coordinating with Glaverbel management before establishing mutual trust. More recently it was Glaverbel that was given responsibility for developing the African, Middle Eastern and Eastern European markets, rather than the domestic glass division. The larger-scale, worldwide operations would require a higher level of coordination and integration by the headquarters. The full ownership of AFG Industries, in particular, would position Asahi Glass in direct competition with the American glass manufacturers, some of which would in return demand the opening of what was claimed to be the "closed" Japanese glass market. Although overseas expansion in glass looked like an easy way to grow, President Seya was wondering if the company was truly committed to taking a global approach with more integration and coordination of operations.

Slow Growth of Electronics

In Japan, despite its decade-long efforts to develop the business, Asahi Glass was still struggling to establish a firm position in the fast-cycle electronics industry beyond its existing activities. In the LCD business, new thin-film-transistor (TFT) technology had been introduced, and major electronics firms such as Hitachi, Toshiba and NEC with strong skills in semiconductor

manufacturing had entered the now-large market. While Asahi Glass had established a second joint venture with Mitsubishi Electric, Advanced Display Inc., for the manufacture of TFT active-matrix LCDs, Mitsubishi Electric had taken a leading role in this venture with an 80% shareholding. Similarly, although Asahi Glass and Komag, Inc. agreed upon a second joint venture for developing thin-film heads for disk drives in 1991, top management realized that the disk head was an “assembly” business, distant from a “materials” business, and that they had stepped into a business in which the company lacked expertise.

Emerging New Glass Opportunities

The emerging opportunities in “new glass” did not come with any clear indication as to what direction the company should take. Although the definition of new glass was yet clear, it was understood to be glass with inherent functions such as selective light transparency, photoconductivity, and electrical insulation or with improved characteristics such as high surface flatness and machinability. Membership in the New Glass Forum, an association established on the initiative of MITI in 1985 to promote information exchanges, ranged from glass manufacturers to chemical, metal, electronics, cable and communications, machinery, and printing companies. The diversity of the membership illustrated the uncertain potential of this new technology. Electrically-insulated ultra-flat glass substrates for LCDs and memory disks, and architectural glass that excluded ultra-violet light were some examples of new glass already under development.

Chairman Furumoto frequently advocated the “restoration of glass.” He said, “It was a mistake that the company had termed glass a ‘mature’ business in the middle 1970s.” Under his leadership, Asahi Glass established a Fine Glass Division in 1985 and a New Glass Research Laboratory in 1988, while also taking leadership in the New Glass Forum. Some industry observers viewed the future of the new glass business as rosy, expecting it to reach \$20 billion by the turn of the century, and were optimistic about Asahi Glass’s capacity to take advantage of it. Others pointed out that the most promising applications for “new glass” would be in the high technology fields whose competitive environments were far different from the traditional glass business.

Challenge of Combining Technological Expertises

Management believed that in the future it would be important to integrate its various technological expertises if it was to capitalize both on new glass technology and on other growth opportunities. President Seya emphasized that while Asahi Glass had traditionally focused on deepening technological expertise within each of its business areas, he believed that it could combine these expertises to develop unique products. One example was a bi-layer glass for automobiles which combined a layer of glass and that of urethane to improve safety. In 1990, the company agreed with Saint-Gobain to jointly develop it. Another example was a fluoropolymer-coated automotive window glass which repelled water more effectively. Integrating the company’s various expertises would, however, not be an easy task, for the company was not used to such coordination, and the cultures of the various divisions often differed.

Revitalizing Corporate Culture

Management recognized that changing the climate of the organization was its biggest challenge. They felt that as the company grew older and larger, its founding “pioneer spirit” had faded away. The company historically had relied on developing new products from its technologies, and was not good at developing products that met customer needs. Chairman Furumoto, the first marketing executive to head the company, had been trying to create an entrepreneurial culture in the company where “wind can blow through” the organization—across divisions, and up and down hierarchies, as well as to promote “market in” customer-focused approaches. His belief was that top management’s role was to create an environment that encouraged initiative and innovation.

Future Direction

One morning in the middle of September 1993, President Seya was reviewing the report on the electronics business prepared by the corporate planning staff. The report analyzed the strategic position of its major products, discussed the company's long-term strategy for this business, and proposed several strategic options. These options ranged from the extreme of divestment to another extreme of aggressive investment. While Asahi Glass would benefit if it could establish a strong foothold in this fast growing business, given the fierce competition, the establishment of such a position would be extremely costly, and its success was not guaranteed. President Seya felt that the discussion around the electronics business was illustrative of the company's dilemma in determining its strategic direction. Whatever action the company would take in this business, it should be aligned with those in other lines of business, and consistent with the company's overall direction for the coming decade.

Exhibit 1 Asahi Glass Company Financial Summary

	Millions of Yen										Millions ^b of Dollars
	1992	1991	1990	1989	1988	1987	1986	1980	1975	1970 ^a	1992
Consolidated											
Net sales	1,316,789	1,248,083	1,233,908	1,093,033	986,983	862,531	836,446	471,875	241,804	137,393	10,534
- Glass and related	739,911	675,191	677,544	579,137	542,543	482,541	479,106	268,936	140,809	94,001	5,919
- Chemical	390,139	382,143	371,483	357,149	313,608	270,272	266,768	177,37	89,559	35,948	3,121
- Ceramics and refractories	31,044	32,309	32,199	26,892	22,205	23,585	23,978	17,981	11,433	7,445	248
- Electronics	74,155	80,333	80,930	61,545	49,944	36,169	36,230	-	-	-	593
- Others	81,540	78,107	71,752	68,310	58,683	49,964	30,364	7,619	-	-	652
Gross profit	229,414	246,695	241,836	244,172	215,227	188,504	172,415	111,159	51,377	42,051	1,835
Selling, general, administration	180,492	175,764	164,025	140,208	125,352	116,082	113,990	64,076	40,552	24,409	1,434
Operating income	48,922	21,372	24,498	23,033	13,045	10,231	7,888	47,083	10,825	17,641	391
Income before income tax	49,646	72,895	91,726	115,796	98,203	76,9698	60,954	43,354	1,198	15,228	397
Net income	24,269	37,672	46,864	59,094	46,083	34,928	28,8322	23,254	5,778	10,028	194
Cash	5,689	7,942	4,765	5,619	27,272	3,586	10,253	NA	NA	NA	130
Total assets	1,515,626	1,447,824	1,216,142	1,226,638	1,020,377	932,308	822,961	456,520	366,197	183,751	12,125
Long-term debt	244,488	295,730	193,420	202,361	155,732	142,462	108,296	31,333	112,404	32,029	1,956
Shareholders' equity	596,709	584,930	557,645	515,307	450,692	393,475	328,393	183,878	101,317	67,806	4,774
Return on sales (%)	1.8	3.0	3.8	5.4	4.7	4.0	3.4	4.9	2.4	7.3	1.8
Return on assets (%)	1.6	2.6	3.6	4.8	4.5	3.7	3.5	5.1	1.6	5.5	1.6
Return on equity (%)	4.1	6.4	8.4	11.5	10.2	8.9	8.8	12.6	5.7	14.8	4.1
Nonconsolidated											
Sales	1,011,815	1,022,064	1,018,085	925,931	834,421	721,234	703,408	471,875	241,804	137,393	8,095
Net income	20,484	37,004	40,536	45,076	42,055	32,518	26,389	23,254	5,778	10,028	164
Research and development ^c	25,475	25,530	26,893	22,893	17,671	15,608	15,174	6,350	3,210	1,745	204

Source: Asahi Glass Company

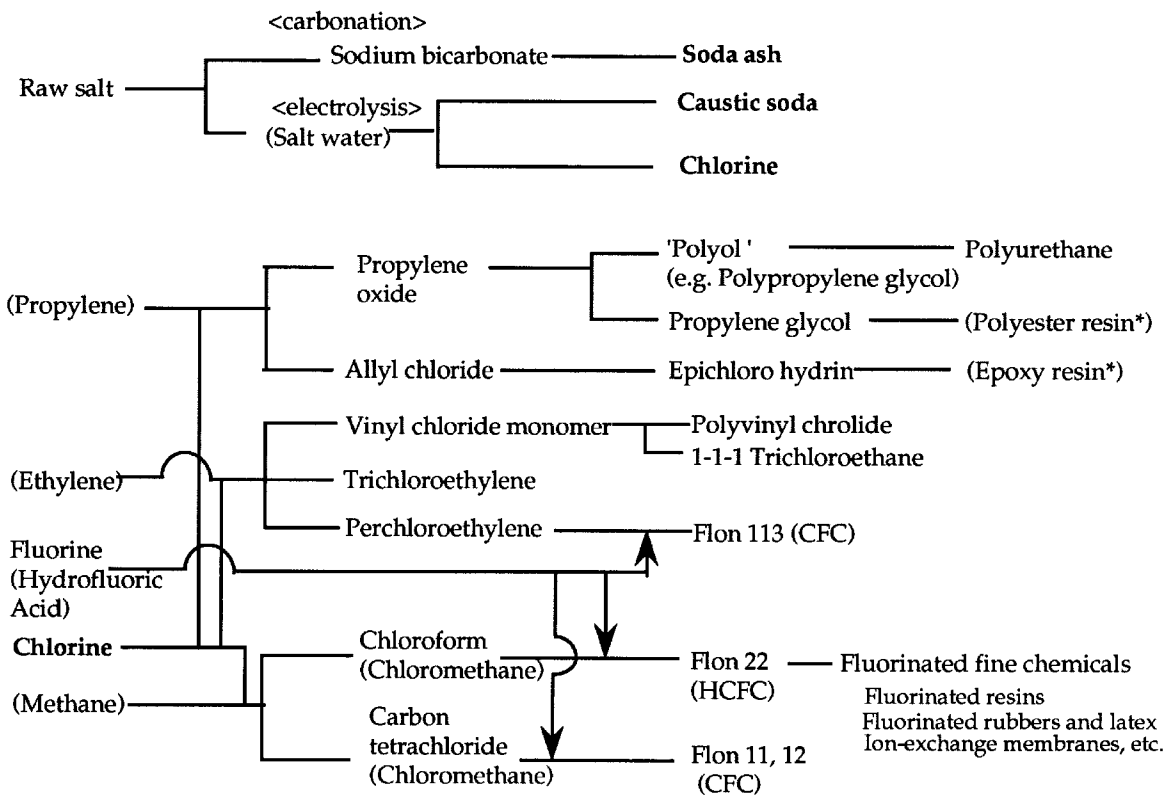
^aNumber ofr 1970 through 1980 were on a nonconsolidated basis.^bExchange rate: ¥125/\$.^cConsolidated R&D expenditure data was not available.

Exhibit 2 Chronological History of Asahi Glass Company

1907	Founded by Toshiya Iwasaki.
1909	Started production of sheet glass for the first time in Japan
1916	Started production of refractory bricks for in-house use.
1917	Started production of soda ash to provide a raw material for glass.
1932	Started production of caustic soda.
1954	Started production of glass bulbs for TV tubes.
1956	Established Indo-Asahi Glass Co., Ltd. (first overseas entry after WWII). Founded Asahi Fiber Glass Co., Ltd. with Owens-Corning Fiber Glass Corp. Started automotive fabricated glass operation.
1961	Started production of propylene oxide and propylene glycol (first entry into organic chemical business).
1964	Started production of fluorinated hydrocarbons.
1966	Introduced float glass process from Pilkington Brothers in the U.K. Entered into an agency marketing contract with Croning Glass Works Co., Ltd. to sell imported ICs (first entry into electronic related business).
1972	Established P.T. Asahimas Flat Glass Co., Ltd. in Indonesia. Developed fluorinated resin.
1973	Introduced GRC technology from Pilkington Brothers in U.K.
1974	Developed glass delay line in response to request from domestic electric makers.
1975	Developed ion-exchange membranes and chlor alkali process to produce caustic soda.
1976	Established OPTREX Corp. with Mitsubishi Electric Co. and started sales and production of liquid crystal displays.
1980	Developed structural ceramics.
1981	Made equity participation in Glaverbel in Belgium and MaasGlas in Holland.
1982	Started full-scale marketing of ophthalmic lenses, frames, and equipment.
1984	Made equity participation in Nippon Carbide Co., Ltd. and ELNA Co., Ltd.
1985	Founded Electronic Products Development Center.
1986	Established Asahi Glass Building Materials to expand building material business.
1987	Founded Asahi Komag Co., Ltd. (a joint venture with Komag of the United States) to manufacture thin-film magnetic disks in Japan.
1988	Established sales companies for sheet glass and building materials in Los Angeles (U.S.) and Hong Kong. Established Corning-Asahi Video Products, a joint venture that took over Corning's U.S. facilities for manufacturing TV glass bulbs.
1990	Established Tenneco Soda Ash Joint Venture with Tenneco Minerals to produce natural soda ash in the United States. Made equity participation in Splintex and established AS Technology S.A. in Belgium to set up automotive safety glass production capability in Europe.
1990-91	Made equity participation in Glaverbec Inc. in Canada, and Glav-Unionin Czechoslovakia through Glaverbel.
1992	Announced the acquisition of the remaining interests of AFG Industries.

Source: Asahi Glass Company

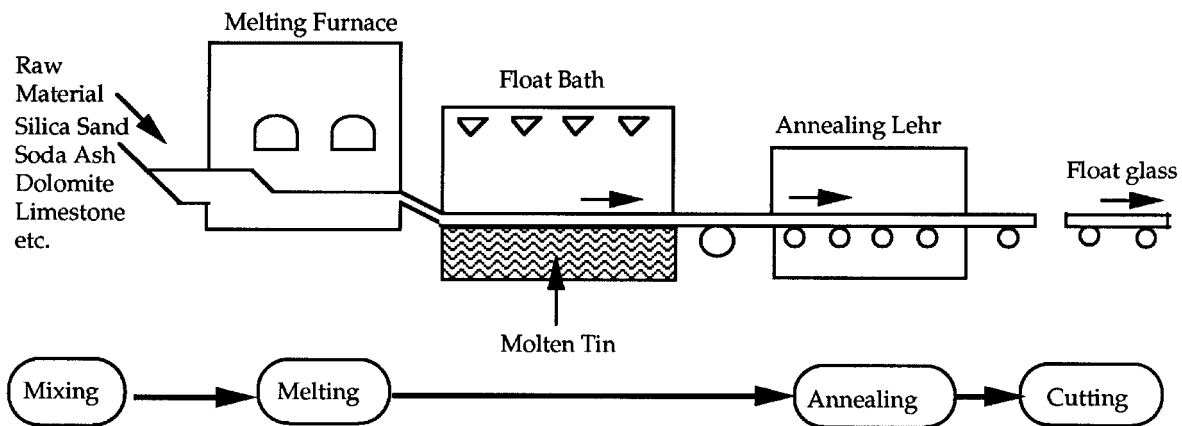
Exhibit 3 Derivation of Chemical Products



* Asahi Glass did not manufacture polyester resin and epoxy resin itself.

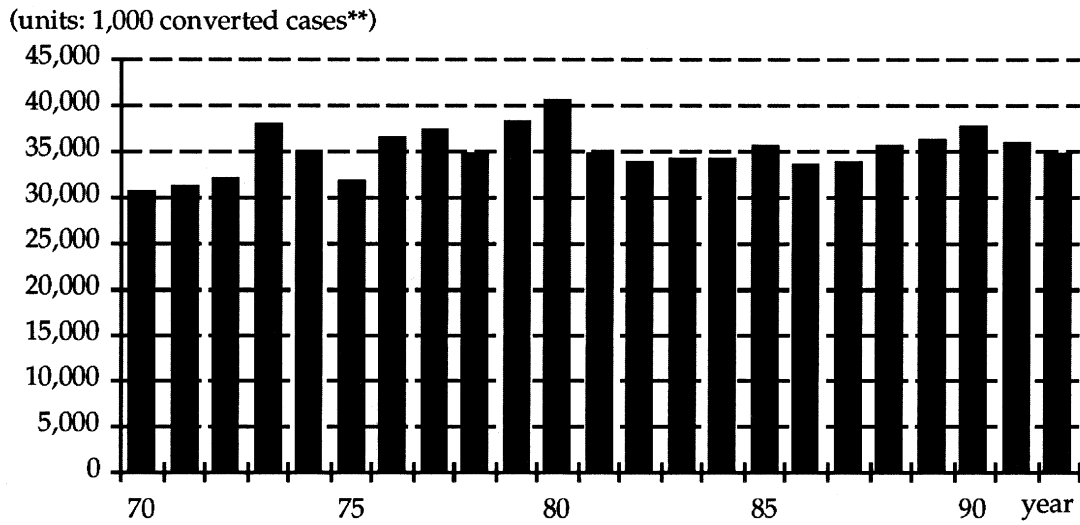
(Source: Asahi Glass Company with addition and modification by the author)

Exhibit 4 Float Glass Process



(Source: Asahi Glass Company)

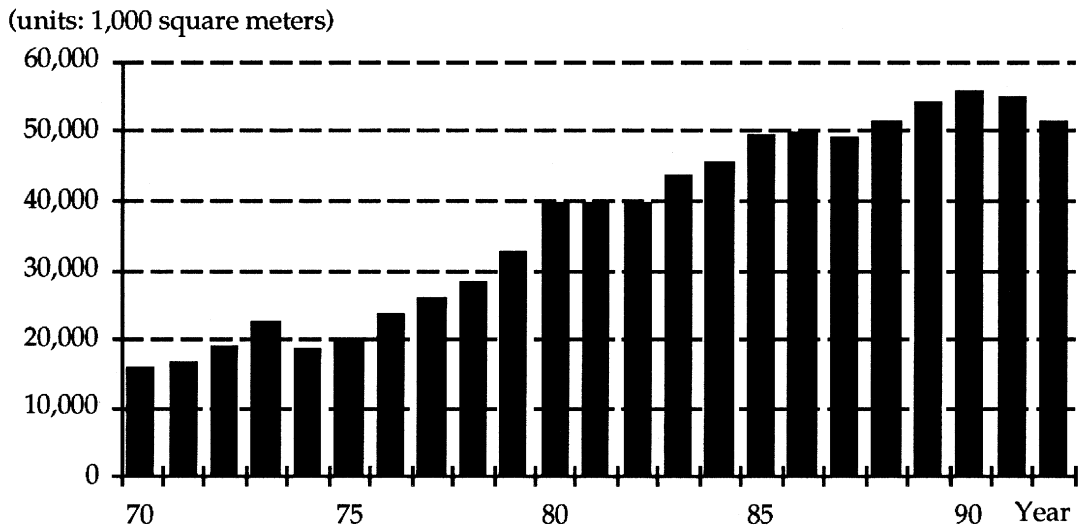
Exhibit 5 Development of the Japanese Glass Industry



* including float glass, polished plate glass, sheet glass and figured glass.

** One converted case equals 9.29m² with 2 mm thickness.

Production Trend of Safety Glass***



*** including tempered glass and laminated glass for both construction and industrial use

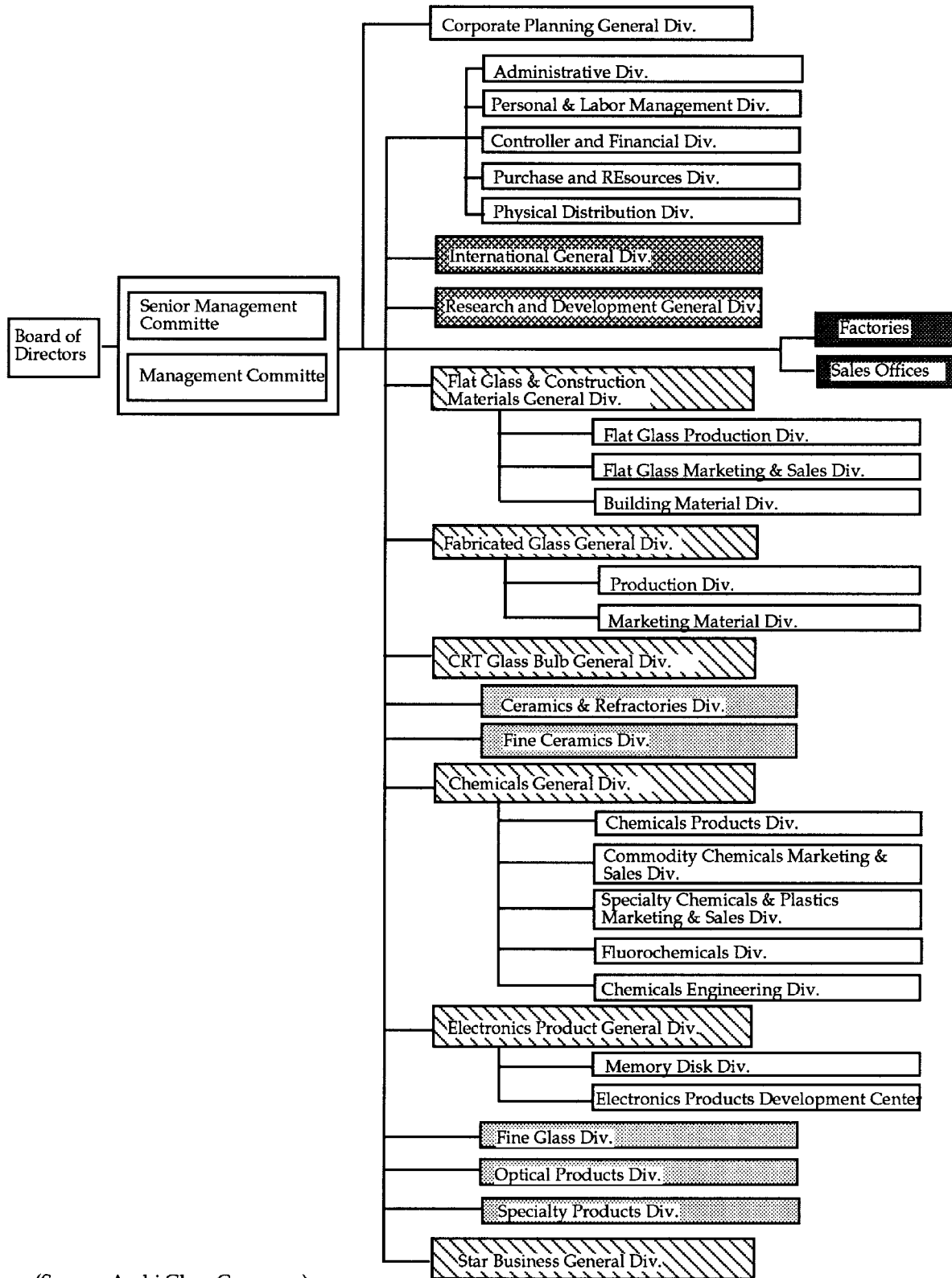
(Source: Flat Glass Association of Japan.)

Exhibit 6 Asahi Glass' Major Businesses and Products in 1992

Area/Sales	Major Products	Major Competition
Glass and Related ¥739,911 mil (56.2%)	Architectural Glass - float glass, tempered glass, laminated glass, - wired-glass, double-gazing units, mirror Construction materials - (a) GRC products, (b) ALC (autocraved lightweight cement) Automotive Safety Glass - laminated safety glass, tempered safety Glass CRT Glass Bulbs - TV glass bulbs and other products Fine Glass and Other Glass Products - (a) ultra-thin glass substrate, (*b) conductive glass substrate, (c) photomask glass substrate, (d) borosilicate-glass products, (e) glass fiber	Nippon Sheet Glass, Central Glass (global) Pilkington Brothers, Saint Gobain, PPG Industries, Gardian (a) Matsushita-Denko, Nichiba, Kubota (b) Asahi Chemicals, Nihon Iyton, Onoda Durox Nippon Sheet Glass, Central Glass (global) Pilkington Brothers, Saint Gobain, PPG Industries, Guardian Nippon Electric Glass (global) N.V. Philips, Schott, Sam-Sung Corning (a) Nippon Sheet Glass, Central Glass, Nippon Electric Glass, (b) Geomatec, Sanyo Cacuum Ind. (c) Shin-Etsu Quartz Products, Toshiba Ceramics, Hoya, (d) Toshiba Glass (e) Nippon Micro Glass-Wool, Paramount Glass Mfg., Nippon Muki
Chemicals ¥390,139 mil (29.6%)	Alkali Chemicals - soda ash, caustic soda, sodium bicarbonate Chloro-Chemicals - hydrochloric acid, liquid chroline, propylene oxide, propylene glycol, polyol, vinyl chloride monomer, polyvinyl chloride (PVCs), epichloro hydrin, chlorinated methane, perchloroethylene, trichloroethylene Fluoro-Chemicals - CFCs (fluorinated hydrocarbons), fluorinated resins, fluorinated rubbers, specialty materials, coating materials	Tosoh, Tokuyama Soda, Central Glass Daikin, Showa Denko, Mitsui-DuPont Fluoro Chemicals (global) FMC, Dow, 3M, ICI, DuPont, ATO Hoechst, Allied
Ceramics and Refractories ¥31,044 mil (2.4%)	(a) fusion cast refractories, bonded refractories, castable refractories, aluminous cement (b) fine ceramics (high strength ceramics, low-expansion ceramics, ultrapure aluminum nitride ceramics), ceramic heat exchangers, ceramic blowers, ceramic valves	(a) Shingagawa Refractories, Kurosaki (b) Kyocera, Toshiba Ceramics
Electronics ¥74,155 mil. (5.6%)	(a) Semiconductors and semicustom ICS, printed thick-film products and hybrid ICs, (b) delay lines, delay line modules, (c) aluminum electrolytic capacitors, electprinted circuit and mounted boards, (d) LCD displays, (e) thin-film magnetic disks	(a) IC trading firms (Ryoyo Electronics etc.) (b) KINSEKI (c) Nichicon (d) Sharp, Toshiba, Seiko-Espon, Sanyo, Hitachi, Hoshiden (e) Fuji Electric, Showa Denko, Mitsubishi Kasei
Others ¥81,540 mil. (6.2%)	(a) ophthalmic and optical products (b) health and medical products (ultrasonic foamers, purifiers, far-infrared sauna etc.) (c) FRP (fiber reinforced plastics) precision-molded products	(a) Hoya, Seiko, Toray Industries

Source: Asahi Glass Company

Exhibit 7 Asahi Glass Company Organization Chart



(Source: Asahi Glass Company)

Exhibit 8 Domestic Glass Industry (FY 1992) (millions of yen)

	AGC Group (December '92)	Nippon Sheet Glass (March '93)	Central Glass (March '93)	Nippon Electric Glass (March '93)
Net sales	1,316,789	286,564	203,881	205,170
Operating profit	42,434	6,672	6,310	9,128
Net income	24,269	1,115	495	2,593
Total assets	1,515,626	427,287	239,062	303,941
Shareholder's equity	596,709	150,588	54,232	105,305
Return on sales	1.84%	0.39%	0.24%	1.26%
Return on assets	1.60	0.26	0.21	0.85
Return on equity	4.07	0.74	0.91	2.46
R&D expenditure ^a	38,000	11,000	6,000	8,500
Employees ^a	9,924	4,001	2,612	4,518
Glass Plants in Japan:				
- Flat glass	4	3	2	0
- Fabricated glass	3	4	2	0
- CRT glass bulb	2	0	0	2
Composition of net sales:	Glass & construction: 56% Chemicals: 30% Ceramics: 2% Electronics: 6% Others: 6%	Glass: 66% Building materials & others: 34%	Glass and building materials: 64% Chemical products 25% Fertilizers: 11%	CRT Tubes: 59% Tubing glass: 8% Glassfibers: 12% Other glass: 20% Glass-making machines 2%

Source: Asahi Glass Company, Annual Reports of Respective Companies

^aNonconsolidated.

Exhibit 9 Worldwide Glass Industry (FY 1992) (million of U.S. dollars)

	AGC Group^b (December '92)	Pilkington^b (March '93)	PPG (December '92)	St. Gobain^b (December '92)	Guardian^c
Net sales	10,534	4,545	5,814	13,981	1,200
Operating profit	391	155	662	1,212	NA
Profit before tax	397	72	542	722	NA
Net income	192	(35)	319	449	NA
Total assets	12,125	4,368	5,662	17,918	NA
Shareholders' equity	4,774	1,604	2,699	7,357	NA
Return on sales	1.84%	(0.78%)	5.49%	3.21%	NA
Return on assets	1.60	(1.41)	5.63	2.51	NA
Return on equity	4.07	(2.22)	11.82	6.10	NA
R&D expenditure	304	88	221	NA	NA
Employees	9,826	41,600	32,300	104,002	8,000
Float Glass Production					
Float plants ^a (total):	29.0	26.5	18.0	17.0	13.0
- Asia & Oceania	14.0	4.0	1.0	0.0	2.0
- North America	8.0	6.0	13.0	0.0	6.0
- Central & South America	0.0	4.5	0.0	1.5	1.0
- Europe	7.0	11.0	4.0	15.5	4.0
- Others	0.0	1.0	0.0	0.0	0.0
Composition of net sales:	Glass & construction: 56%	Glass: 80%	Glass: 37%	Glass: 18%	Glass: 80%
	Chemicals: 30%	Insulation: 3%	Coating & resin: 40%	Ceramics: 14%	Photofinishing laboratories: 15%
	Ceramics: 2%	Visioncare: 12%	Chemicals 19%	Containers: 17%	Others: 5%
	Electronics 6%	Optronics: 2%	Others: 4%	Insulation: 13%	
	Others: 6%	Others: 3%		Paper-wood: 12%	
				Pipe: 11%	
				Building materials: 9%	
				Fiber reinforcements: 4%	
				Others: 2%	

Source: Asahi Glass Company; Annual Reports of Respective Companies; *Forbes* "The 400 Largest Private Companies in the U.S.", December 6, 1993

^aAs of February 1992 (including float tanks in cold repair and under construction). A joint venture plant operated by two companies was counted as 0.5 plant for each company.

^bExchange rates: ¥125/\$, \$1.7663/£, FF5.2935/\$.

^cprivately-held company

Exhibit 10 Asahi Glass' Position in Electronic Businesses

	Asahi Glass's Involvement (Asahi's Share)	Major Electronic Products	Sales in 1992	Market Size in 1992 (Worldwide)	Relative Position/ Market Share	Major Competitors	Market Growth	Relevance for Asahi Glass's Other Businesses
Electronic Product & Specialty Product General Divisions	Internal divisions	<ul style="list-style-type: none"> glass delay lines sales of ICs & semicustom ICs 	¥3 billion NA	¥12 billion NA	Among top three low share	KINSEKI, Matsushita Electronic Component Ryoyo Electronics, Tokyo Electron, Nissei Sangyo, Ryosan	Flat Very high	<ul style="list-style-type: none"> supplier to TV sets manufacturers
OPTREX	joint venture with Mitsubishi Electric (60%)	<ul style="list-style-type: none"> passive-matrix LCDs 	¥36.0 billion	¥325.5 billion (including passive- & active-matrix LCDs)	Among top five	Sharp, Seiko Epson, Sanyo, Citizen Watch Casio Computer	About 10% p.a.	<ul style="list-style-type: none"> Glass substrate Expertise in chemical compounds
Advanced Display Inc.	Joint venture with Mitsubishi Electric (20%)	<ul style="list-style-type: none"> TFT active-matrix LCDs 	Joint development will be completed by September 1994		(No production yet)	Sharp, Toshiba, NEC Hitachi, Hoshiden	30%-40% p.a.	<ul style="list-style-type: none"> Use of automotive panels
Asahi-Komag	Joint venture with Komag Inc. (40%)	<ul style="list-style-type: none"> Thin-film magnetic disks 	¥10-15 billion	¥60 billion	Among top four	Fuji Electric, Showa Denko, Mitsubishi Kasei	Medium-high	<ul style="list-style-type: none"> surface treatment skills (e.g., sputtering) application of glass to disk substrates
ELNA	Largest shareholder (25%)	<ul style="list-style-type: none"> aluminum electrolytic capacitors printed circuits 	¥16.6 billion ¥8.4 billion	¥498 billion (all capacitors) ¥885 billion	Among top six in aluminum electrolytic capacitors NA	Nichicon, Nippon Chemi-con Murata Manufacturing Nippon CMK, Hitachi Chemicals, Ibdien	Almost flat Flat or slight increase	<ul style="list-style-type: none"> Discrete electronics business
Nippon Carbide	Largest shareholder (18%)	<ul style="list-style-type: none"> Electronic materials 	¥5 billion (10% of total sales of the company)	NA	NA	Kyocera, Noritake Co., Ltd.	NA	<ul style="list-style-type: none"> Ceramic processing technology

Source: 1992 Annual Reports of Asahi Glass, ELNA, and Nippon Carbide: Relative position/market share, market growth, and the numbers for Optrex are estimated by the author