Chapter II

Oil Crisis and New Business (1972–1987)

Coping with Oil Crisis

In January 1972, Yoshio Tsuchiya became chairman of Daikin and Minoru Yamada, the eldest son of founder Akira Yamada, became president.

A year earlier, after the U.S. removed the dollar from the gold standard, the Japanese yen appreciated significantly versus the dollar. The change of presidents at Daikin thus took place in difficult circumstances as the yen's appreciation led to a low level of private investment in plant and equipment. There was no way for the company to prevent a decline in its business. Chairman Tsuchiya expressed his main expectation regarding the new president by saying he would like to see him break from tradition and

Minoru Yamada named Third President

build a new Daikin. President Minoru Yamada emphasized three management principles at that time: the first was to create a new Daikin atmosphere filled with youth and vitality; the second was to expand and widen the company's business fields to contribute to its growth and development; and the third was to maintain the autonomy of the Daikin group's unity through mutual trust.

Minoru Yamada graduated in 1944 from the Engineering Department of the Imperial University of Tokyo where he majored in aircraft engines. He entered Mitsubishi Heavy Industries after graduating and was assigned to the company's aircraft assembly plant. Before long, however, he was called up for military service. When the war ended in 1945 he was a navy lieutenant in a technical position. Because GHQ prohibited Japan from producing aircraft, the Japanese aircraft industry was dealt a damaging blow in the postwar years. Yamada decided to enter his father's company after leaving the navy. He also convinced several outstanding technicians with whom he was friendly in his university years to join the company with him. Those technicians contributed much toward Daikin, which later became widely known for its technical competence. Over the years, those technicians in turn nurtured many young technicians who entered the company.

As one of his management principles, Minoru Yamada emphasized the need "to form a network of people." He practiced

that principle himself through his activities in the Kansai Association of Corporate Executives (KACE) and other organizations, and he urged the company's higher executives to practice the same principle. KACE is a local association of the Japan Association of Corporate Executives (JACE), an organization for business executives established after the war. Soon after its establishment JACE spoke out and acted forcefully concerning economic issues both inside and outside Japan. Minoru Yamada joined KSCE in 1954, around the time Daikin had largely recovered from its chaotic postwar period. He learned much at that time from exchanges with KACE members such as Hosai Hyuga, president of Sumitomo Metal Industries, Ltd. (today's Nippon Steel & Sumitomo Metal), Norishige Hasegawa, president of Sumitomo Chemical, and other members of the Kansai Association of Corporate Executives, a group of dynamic company leaders who represented Kansai business circles. In 1972, Yamada headed the first group of top-level businessmen in KACE who toured six countries in Southeast Asia, and acted forcefully to assuage increasing anti-Japan sentiments in the area. KACE members continued to make efforts afterward as well to promote exchanges between Japan and Southeast Asian countries, effectively bolstering private-sector diplomacy. Yamada's wide-ranging activities contributed toward building a "network of important persons" at home as well. Vice President Yoshikuni Inoue, Senior Managing Director Noriyuki Inoue, and other Daikin executives promoted those activities further and firmed up Daikin's position in Kansai business circles.

In October 1973, not long after Minoru Yoshida assumed Daikin's presidency, the Fourth Middle East War broke out and the oil-producing Arab nations reduced their oil exports while greatly raising prices. The economies of the world's advanced nations, meanwhile, had based the success of their industrial operations

on a continuous supply of inexpensive oil. Japan was no exception, for its domestic oil reserves were not sufficient to meet the country's needs. Compared to European countries, Japan was slow to switch from oil to other energy resources. Oil was not only used as a fuel in Japan but was also the key raw material responsible for the tremendous expansion of the country's petrochemical industry. At any rate, the twin concerns of a shortage of goods and increased inflation caused an economic panic situation to develop in Japan. The prices of consumer goods mushroomed and the government introduced measures to suppress demand, raised the official discount rate, and reduced its expenditures. This marked the outbreak of the First Oil Crisis.

In Japan, where spring is the time for labor negotiations, the negotiations that took place in the spring of 1974 were against a backdrop of sharply rising consumer prices. Most companies ended up paying wage increases of 30 percent or more, and it was important afterward for companies to adjust their product prices quickly upward to absorb the higher costs. They also had to adjust their business structures in such ways as trimming production, conserving energy, and reducing the size of their labor force, comprising a general shift toward quantitative reductions. Daikin's sales in the second half of 1974 decreased by 20 percent compared to the previous year, and the company barely escaped falling into the red.

Daikin did not respond quickly enough in that critical situation, and its product inventories increased rapidly. Between December 1974 and the following May, in fact, the company was forced to introduce emergency countermeasures such as halting operations, especially at the Sakai and Yodogawa plants where operations centered on air conditioners for commercial use, refrigerators, and oil hydraulic machines. The countermeasures included about 40 days of halted operations. In December 1974, meanwhile, President Yamada sent an emergency message concerning the dire situation to all members of junior management in Daikin. Afterward, the company quickly introduced basic countermeasures and President Yamada announced that everything possible would be done to prevent layoffs. He also said the company would introduce wide-ranging remedial measures and asked the employees to work together in carrying them out. He personally visited as many business sites as he could and spoke directly with the local managers. He told them their leadership during this difficult time would serve later to build relationships of trust at the worksites, and strongly urged them to increase their local sales capabilities and introduce bold measures to reduce costs.

President Yamada felt strongly about avoiding layoffs. After the war, when Daikin was forced to lay off personnel every time the U.S. military's procurements policy changed, President Akira Yamada had to negotiate face-to-face with labor union leaders. Years later, he commented on how empty he felt during the three times he had to approve layoffs. Based on that experience, he said he wanted to make Daikin a company that never again had to lay off workers. He made his main statement around the same time that many Japanese companies were laying off workers, saying that his managerial principles prevented him from allowing layoffs. Such statements heightened the morale of both union and non-union workers in Daikin, and brought them together to fight the crises the company faced. That basic policy took clear form in Daikin's "Managerial principles" formulated in 1990. They included the following comments from Minoru Yamada: "An enterprise is comprised of a group of workers with various individual characteristics. Our company feels it is primarily important to respect the individuality of each employee, and to ensure stable employment."

The post-Oil Crisis expectations for Japan were for zero economic growth. Daikin set five goals to prepare for that eventuality: a more efficient workforce, suppressed wages, reduced costs, higher value added, and growth in new areas. The company introduced various medium- and long-range countermeasures to achieve those five goals, such as bolstering its sales agencies and establishing many new air conditioning equipment sales companies. One particular countermeasure was aimed at increased efficiency among the company's workers. Around the time that the demand for products decreased seriously, there were about 450 excess workers in the plants. The company handled that problem in ways such as training them for duties in other divisions. Most of the excess workers ended up in the sales departments, with many of them being transferred to external sales companies handling air conditioners or oil-hydraulic equipment, thus boosting the company's overall sales capabilities. Also, beginning with the design division, operations that had been outsourced, such as copying and guard duties, were brought back inside the company, which increased the number of employees assigned to new internal duties. Also, an employee franchise system was introduced for employees who chose to become independent and operate their own companies. In such ways, Daikin introduced various countermeasures to move personnel to substitute duties inside or outside the company. As a result, the 6,350 employees in Daikin in April 1974 were reduced to 5,799 by June 1979 through moves such as decreasing the hiring of new employees and transferring existing employees to external organizations. During that same period, however, there were zero layoffs and no one was fired. Among other moves, the salaries of managers were reduced by 10 percent from January 1975 to have them share the responsibility for the company's deteriorated business results and the difficulties that

Daikin's 50th Anniversary Celebration

union members were experiencing, including no overtime work and no special days off. In addition, President Yamada deliberated over many hours with members of the Daikin union, which had only recently bolstered its organization, asking for their cooperation in shouldering the difficulties the company was experiencing, deepening the relationship of mutual trust between the two parties, and carrying out a series of measures to break from the trying situation. To the families of employees, meanwhile, who felt uneasy about the company's difficult circumstances and the special time off, the company clarified the situation to them and wrote personal letters that emphasized the company's bright future, thus easing the apprehension the employees and their families felt.

Dakin celebrated its fiftieth founding anniversary in October 1974, in the context of a business downturn caused by the Oil Crisis. In his greetings to the employees at that time, President Yamada said it was especially important to improve the company's structure in the difficult circumstances of low-level economic growth, and to be determined to accept the challenge of achieving new growth. As issues the company must face, Yamada mentioned achieving cost competitiveness, bolstering the company's

sales capabilities, and accumulating development capabilities, and he asked the employees to tackle those problems autonomously. The company celebrated its fiftieth anniversary forcefully, even in the difficult circumstances surrounding management at the time. It also distributed copies of the company's 50-year history to all employees, and contributed toward support of the Yamada Scholarship Foundation, founded with the personal funds of Akira Yamada. Separately, it also established an Orphans Pension Fund.

Disastrous events such as the Nixon Shock of 1971 and the Oil Shock of 1973 dealt severe blows to Daikin's Chemicals Division. In addition, besides the yen's sharp upward evaluation on the world's money markets, the Japanese duties on imported fluororesins decreased, a special duty was placed on all imports into the U.S., and there were sharp increases in the prices of raw materials, fuels, and labor, causing a drop in the international competitiveness of fluororesins. Several new companies also entered the domestic fluororesin market because of the product's high value-added ratio, and some companies already in the market, such as Mitsui Fluorochemicals (today's Du Pont-Mitsui Fluorochemicals Co., Ltd.) and Asahi Glass Co. developed and marketed new fluororesin products that contributed to promoting increased competition. Daikin, as a frontrunner in Japan's fluororesin market, met the increased competition by reducing costs, developing new products, and entering new related fields. All-out reform of the operating system in the Chemicals Business Division and more efficient operation of facilities led to wide-ranging cost reductions so that in fiscal years 1975-76, when the overall company reported deficit operations, the Chemicals Business Division reported a profit. It steadily improved its profits until 1985.

Daikin began increasing its overall sales in fiscal 1976, and

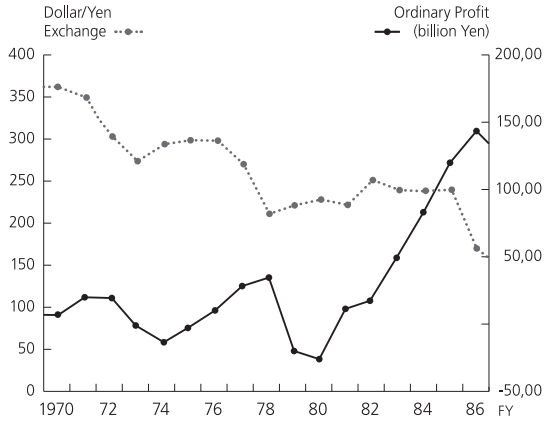
reported current profits in the black in 1977. It thus took over two years from the outbreak of the Oil Crisis for the company to bolster its business structure. Although many Japanese companies overcame the crisis by reducing the number of employees, Daikin made it through the same crisis without laying off any employees. In 1977, Daikin reviewed the plan it had in place when business came to an unexpected halt, and based on it introduced a new three-year business plan, Vision 55, to run until 1980. The company systematized the measures it introduced to combat the Oil Crisis and strengthen the company's business structure, aiming simultaneously to create a corporate structure filled with vitality and an innovative spirit. Also, under the leadership of Yoshikuni Inoue, head of the General Planning Section, conferences were held throughout the company to pinpoint R&D themes for Daikin to tackle in the middle to long term. One result of that project was the emergence of possible new businesses in electronics for Daikin to enter that would fuse technologies as different as machinery, chemicals, and electronics.

From 1975, Daikin began using a new personnel system largely based on employee capabilities. In the typical Japanese personnel system, many companies aim to keep outstanding employees by educating them further in-house after they join the company right after graduation from the university, and increasing the wages of most of them each year. Companies also guaranteed employment until retirement. Actually, Japanese companies designed that system during the country's period of high-level economic growth, when there was a shortage of labor. The two main features of the system were seniority-based wages and a guarantee of employment until retirement age. Daikin, meanwhile, experienced rapid growth and many of its employees joined the company partway through their careers, making a fair evaluation of

their capabilities all the more important. Ahead of other Japanese companies, Daikin introduced a personnel system emphasizing the qualifications of employees in 1969. In utilizing that system, Daikin added aspects of the regular Japanese system that had only slight wage differences between employees who joined the company at the same time. The personnel system was thus complicated, and the company introduced a new system in 1975 that emphasized a worker's capabilities and selected some young workers for manager training, thus trimming and rationalizing the organization. Combined with the personnel system revisions, management level employees were reevaluated depending on how well they performed their sophisticated duties, thus promoting changes in the thinking of workers.

Next, in 1979, Daikin introduced an age-limit system for its workers. In the postwar period, the company reduced its workforce size three times. The company grew rapidly afterward, however, and over a period of several years, beginning in 1958, it brought in about 1,000 new workers. Then it held back again on hiring large numbers of new workers after the Oil Crisis in the early 1970s. One result of Daikin's system was that its workforce aged more rapidly than in other companies, and it became an urgent task for the company to utilize its middle-age and older employees actively. A step the company took was to move the retirement age for employees forward to 60, the age at which the company reviewed each person's capabilities, type of work, and salary. It also introduced a system for assisting employees who wanted to leave Daikin and open their own businesses or work for other companies. Central to Daikin's thinking was the motto "Management without layoffs." The company pushed that thinking further by building workplaces where employees would want to work. Daikin's system eventually became a model case for Japanese companies that later began extending the maximum retirement age of their employees.

Yen Exchange Rate and Current Account Balance



Daikin's business performance, both sales and profits, began improving steadily from 1977. Although the company's ordinary profits dropped in fiscal 1980 due to the Second Oil Crisis, its total sales increased, leading to increased revenue. It then established a new five-year plan in 1980, called Vision 60. At that time, President Yamada said:

"The targets we aim for should be flexible enough to respond to business changes and weather shifts, and allow us to build a bold and stable business structure for adapting to all types of business weather. We must also make Daikin a company that emphasizes technology, remains a step ahead of other companies in developing new products, and assumes an immovable position in its industry."

In the early 1980s, the Japanese economy was suffering from the recession tied to the Second Oil Crisis. Although the domestic economy was in a recession, however, exports were increasing rapidly, and Japanese companies came to be known for their

strong international competitiveness and overwhelming trade surpluses, thus completely overturning their international evaluation. A number of books praised Japan's economic successes, including Ezra Vogel's Japan as Number One, and when Japan entered the second half of the 1980s the Japanese over-evaluated themselves and became arrogant. But for Daikin, the qualitative and quantitative goals set in its Vision 60 (60th year of Showa =1985) and Vision 65 five-year plans, were accompanied by an emphasis on technological successes, which made the company continue to improve itself over the decade between 1985 and 1995. Two of the years just before the start of that period, however, 1980 and 1982, were recession years that also had cold summers, dealing Daikin's air conditioning business a double punch. The stronger yen following the Plaza Accord of 1985, meanwhile, badly hurt Japan's exports, the economy's previous driving force. At the same time, the domestic economy suffered from a higher yen, which depressed consumption. Viewed in hindsight, it can be said generally that the energetic efforts of Japanese companies during the first half of the 1980s tied directly to the country's later strong international competitiveness. For certain companies, however, the external business environment during that period was harsh. It was a period in which the differences were clarified between companies that succeeded by following clear policies to speed up their internal reforms and those that did not.

President Minoru Yamada said, "Our goals are not so simple that we can achieve them by making efforts and introducing improvements along the same lines as in the past. Realizing the goals in the Vision 60 five-year plan, for example, will ultimately tie to appreciating the concept of 'Daikin with a future,' a concept filled with expectations." The company's employees took those words to heart, and they worked closely together while making strong

efforts. The harsh experience of a cold summer in 1980 led to a difficult start for Daikin's room air conditioning business. In that situation, the company moved to build a sales structure that would return a profit even if its sales goals were not realized. Although the summer of 1982 was also cold, the company realized a profit in sales of air conditioners. From 1980 to 1984, meanwhile, the company's overall exports tripled, and came to account for 18 percent of the company's total business. The managerial efforts Daikin made starting in 1980 thus began to show results. Those efforts included new product development through investments concentrating on R&D, building a sales system with emphasis on high value-added products, and increasing production efficiency using the Daikin Production System, a version of the Toyota Production System modified to fit Daikin's particular situation.

During the 15 years from 1972 to 1987, Daikin's sales increased four-fold. The chemical business, in particular, increased five-fold during the same period, based principally on the success of its fluororesin sales. In the company's main air conditioning business, packaged air conditioners firmly held top position in the domestic market, and sales of room air conditioners established a firm beachhead. Ordinary profits turned stagnant while the yen was strong, but eventually increased 3.5-fold, with gradual increases up to 1987. In that process, Daikin built its foundation for an "all-weather" corporate structure flexible enough to respond to changes in business and weather conditions.

Aiming for "Daikin, the Technology Company"

Despite experiencing the two oil crises of 1973 and 1979, Daikin strengthened its technology development, and began calling itself "Daikin the technology company." The company developed new technology and entered multiple new business fields. Although

not all the new businesses were successful, they demonstrated that "Daikin the technology company" was willing to take trial-and-error steps toward achieving its objectives.

In 1973, Daikin renamed the Research Department inside the Sakai Plant the Airconditioning Research Center and began tackling the development of new air conditioning technology. As a reflection of the most advanced issues of the time, research at the new center focused on wide-ranging themes, including environment-related equipment, the freezing and storage of food products, the use of robots, and others. In 1974, Daikin invited Kozo Fushimi, manager of energy-related research at MITI's electronic technology research center, to join Daikin as vice chief of the Airconditioning Research Center (ARC). In such ways, the company bolstered its system for researching electronic technology. In order to respond to the increased attention paid to research themes other than air conditioning, in 1975 the company also renamed the ARC a "Research Center" and moved its main research efforts to the Kanaoka Factory of the Sakai Plant. It also reorganized the Research Center's detached office inside the Yodogawa Plant into two laboratories—an Environmental Research Lab, and a Robot Development Lab. The Research Center's "Control Group" became its central group. In 1979, the company established a separate Electronics Research Center, with the Research Center's "Control Group" as its core member. Kozo Fushimi, the head of the Research Center in the Kanaoka Factory at that time, doubled as head of the Electronics Research Center.

Meanwhile, the Electronics Research Center in the Kanaoka Factory became the center of Daikin's electronics business and it moved to collect information related to electronics technology, make efforts to raise the in-house technical level of electronics, and nurture the company's future electronic technicians. President Yamada had for some time said, "To promote the company's future development and growth, we must assemble personnel with electronics backgrounds to allow our company to break from its leaning toward mechanical technologies." To that end, he promoted a change in Daikin's leaning toward expanding the number of personnel in existing technical fields to the hiring of quite different personnel with backgrounds in electronics technology. And to create situations in which electronics researchers could work comfortably, the company introduced flexible work environments. The company also established Daikin Electronics College in 1982, making it a base for cooperation between industry and academia and a focal point for industrial schooling in Japan. Aimed at totally new employees and technical employees working with machinery, meanwhile, Daikin began developing technical personnel in the mechatronics field. Although Japanese companies generally started introducing electronics into their businesses in the 1980s, Daikin began even earlier fusing electronics and mechanical engineering technology. That step was due entirely to the foresight of Akira Yamada, the company's founder.

The Daikin Electronics Technology Center (DETC) established a new research center inside the Shiga Plant in 1980, and the company assigned specialist researchers there. Their research focused mainly on inverter controls related to air conditioners, temperature and comfort sensors, and other products. Before too long, the company realized that if DETC remained under the control of the air conditioning department, it could not attract outstanding students of electronics technology to become employees. From 1982, therefore, it began building an all-out electronics equipment business. The opportunity to start that business presented itself in 1981 when the venture company Thyrac contacted Daikin about possible joint development of the world's fastest

graphics display. Although the two companies began jointly developing a three-dimensional graphics display terminal (GDT), the joint venture collapsed in 1982. That same year Daikin established an Electronic Equipment Department and based on unique technology that DETC developed, the company in 1983 developed the GDT DS Series. It delivered the equipment to the Earthquake Research Center in the University of Tokyo and Hokkaido University. In 1985, the Electronic Equipment Department was raised in stature to the Electronic Equipment Division. In that same year Daikin delivered a new model of the GDT DS Series to the Fermi National Accelerator Laboratory in the U.S. Problems related to the product's design emerged at that time, however, and the project did not realize the results Daikin expected. Afterward, the Electronic Equipment Division continued to tackle the development of two-dimensional GDT and other products. In the end, however, in 1993, the company pulled completely out of the electronic hardware business and concentrated all its efforts on software.

After Daikin established a clear system for researching electronics technology, it transferred research functions other than those related to the electronics business to the Mechanical Technology Research Center (MTRC), the company's mechanics R&D center. The MTRC had early on reinforced its relationship with universities, public agencies, private research organizations, and other groups, and after its new start it initiated a system of joint research with industry and the academic community. Some of its main activities included joint research with Tokyo Electric Power Company to develop a Heating/Cooling System Based on the Use of Solar Heat and Ice Chemical Storage, development of a Concentration Difference Engine Heat Pump made possible with subsidies from the Ministry of International Trade and Industry (MITI),

participation in the International Energy Association's joint international project for research into refrigerant blends, and joint research with plant makers and other related organizations in a project titled "Development of a super heat pump energy integrated system." Daikin also participated in joint research with the Futurology Research Laboratory in 1998 concerning possibly establishing a base on the moon's surface and development of the moon's reserves. In 1990, Daikin also conducted joint research with JR Tokai and Toshiba Corporation to develop a freezer for linear motor railway cars.

Daikin also started new businesses in the chemical industry around this time. In 1975, for example, it made good use of its chemical plant technology and established the chemical engineering department inside the Chemicals Business Division with the aim of entering the environmental business. The chemical engineering department developed a honeycomb rotor that used a new raw material called activated carbon powder paper and offered new products such as a honeycomb deodorant device. In 1985, Flecto Co. in Sweden, a major manufacturer of paint booths for automobiles, requested export ties on the honeycomb deodorant device with Daikin, which Daikin agreed to. Afterward, Flecto paint booths equipped with that device came to be installed on the assembly lines of Volvo, Ford, Chrysler, and other prominent automakers worldwide.

Daikin entered the thermal insulation panel business in 1974. Although it failed at first, in order to rebuild the business it separated its Food Products' Cryogenic Equipment Development Department from the Air conditioning Sales Division in 1978. The former then began business as an independent sales department. It developed small prefabricated refrigerators and freezers and started anew in that field as an integrated manufacturer of large

and small low-temperature storage equipment. Also, in response to the needs of newly emerging restaurant chains that were expanding quickly, Daikin entered the business of providing those restaurants with various equipment. It met those needs with in-house development, OEM production and purchasing ready-made equipment. Compared to those of other companies, the ice-makers imported from Whirlpool Corporation of the U.S. and commercial use freezers produced on an OEM basis, however, had no notable features. Daikin also received many complaints about products it developed and produced on its own, related especially to water and electrical leaks due to condensation. They included icemakers, dishwashing machines, and others. Meanwhile, sales for 1984 fell below those for 1983, and the company was unable afterward to develop appropriate countermeasures. Finally, in 1991 Daikin was forced to quit the business related to low-temperature food products equipment.

One example of Daikin's success in the very low temperature and high-vacuum business areas was its technical ties in the area of cryo-refrigerators with Air Products & Chemicals, Inc. (APCI) of the U.S. Cryo-refrigerators allow freezing to temperatures between minus 250 degrees C and minus 269 degrees C. Included in the company's technology is a cryopump that creates high vacuums. Originally, cry pumps served only special needs, such as using them in the material science field. Cryopumps, however, moved into the spotlight together with higher integration becoming possible in semiconductor production processes. APCI's cryopump had few parts, was economical to produce, and Daikin—applying technology it already possessed—could easily develop the exclusive helium-operated compressor the pump used. Daikin thus decided to participate in the production and sale of the cryopump, and in 1983 it signed a technical agreement with

APCI. The field was much more technical than previous projects in which Daikin participated, the design and production processes required an especially high level of precision, and product control required closer attention than previous Daikin projects. Despite the difficulties, the first cryopump emerged safely from the production line in 1984. Centered on the manufacturer producing the ion injection device and other equipment, sales proceeded smoothly, reaching 160 units in 1986. In particular, in the area of applying the superconductive magnet which cryo-refrigerators needed, Daikin acquired a monopolistic share of the nuclear magnetic resonance imaging (MRI) apparatus field. Also, in the area of ultra-fast railways using linear motor cars, JR Tokai installed 4,000 freezers. They were used in multiple test runs on lines in both Miyazaki and Yamanashi prefectures, and their areas of application were widened. Cryopumps, meanwhile, became essential devices in the development and manufacture of very high density semiconductors, and the demand for them increased.

In the area of equipment for use aboard ships, Daikin won orders from the New Zealand Line for the refrigeration units it attached to marine containers and succeeded in developing an outstanding product. The company then introduced the unit to international markets and it sold well. In 1984, Daikin added to that line by developing a super-thin end-wall type unit, also for use in refrigerated containers (reefers). Two of its main customers were Sea Containers Ltd., the world's largest container leasing company at the time (the company bankrupted in 2006), and Overseas Containers Ltd. (today's P&OCL) in the U.K. Europe-based shipping companies, in particular, gave the products high marks. With an increase in number of units sold, Daikin then contracted with maintenance companies in some of the world's busiest ports, at the same time having its employees learn repair

Marine Container with Super-Thin End Wall

methods. Daikin also established a parts supply system, the first time for the company to build service networks tied to local regions. In that background, Daikin's annual sales of refrigeration units in 1983 reached 3,209 units, with annual sales of 6.6 billion yen, thus passing Carrier Corporation and becoming the world's leading company in sales of refrigeration units for containers.

Around this same time, Daikin succeeded in the medical equipment (ME) field, based largely on successful sales after developing new products. The company first considered entrance to the market for home-use health and medical products in 1977, when it tackled the development and marketing of small blood-sugar level meters. Although ME was an atypical field for Daikin, the company successfully developed a high-performance blood-sugar meter in 1987, and began marketing it after receiving the Health, Labor, and Welfare Ministry's approval in 1990.

In these ways, Daikin worked across a wide spectrum of business fields. But the tackling of competitive large-scale projects did not immediately result in the development of new products. Still, the R&D and technical capabilities accumulated in that process, especially electronics-related technology, was utilized later in diverse ways with the development of new technology. Besides raising the level of the company's electronics-related technology, the company's activities at that time also played an important role toward establishing its name as a technology company. The network Daikin built at that time through cooperation with various external organizations later became a valuable asset as well.

Diversification of Air Conditioning Business

Daikin's Air Conditioning Division fell into deficit operations immediately following the Oil Crisis, and the company subsequently made great efforts afterward to rationalize its operations. It discontinued its single-division Air Conditioning Division system in 1978, for example, replacing it with a system of two divisions: air conditioning sales, and air conditioning manufacturing. As a result, the air conditioning business finally turned profitable in 1979. Japan experienced cold summers in 1980 and again in 1982, however, and the company's air conditioning business once again fell into deficit operations. Since air conditioning accounted for about 70 percent of Daikin's business at the time, the company was uneasy about its future, and urgently needed to establish an "all-weather managerial structure."

In that situation, Daikin planned drastic reforms in its air conditioning production and sales operations, aiming at the cost cut of 9 billion yen. Two of its major concerns were more efficient use of the labor force in its air conditioning business headquarters, and a more rationalized distribution system. To tackle those concerns, the company introduced the principle of setting clear priorities to its sales structure in 1983.

The cold summer of 1980 negatively affected the room air conditioning business, which before then had been expanding steadily and was one of the company's mainstay business areas.

At any rate, in 1980 the company was forced to accept a large volume of returned orders, to reduce production, and to lower its air conditioning prices. Sales decreased 14 percent versus the previous year, and business results fell deeply into the red. Construction of the new wing to the Shiga Plant, meanwhile, was completed in November 1980, and its construction costs became an additional burden on the company. Given that situation, Daikin could not escape from deficit operations between then and 1982, almost three full years.

Although the number of commercial-use air conditioners sold since 1974 was stagnant because of the negative influence of the First Oil Crisis, the company managed to keep its overall operations in the black even with the cold summer. The deficit operations of room air conditioners were the main reason the overall air conditioning business was in the red. In that situation, Daikin set in the field of commercial sales a target of securing a 30 percent share of the domestic market for packaged air conditioners, one of its key, more profitable, products. And among its room air conditioners, it positioned its medium, large, and multi-type products as particularly important items, thus building a sales structure that would realize higher profits. In dealing with the direct sales companies that previously sold mainly room air conditioners, Daikin adjusted its policy and had those companies mainly sell packaged air conditioners and medium- or large-size and multi-room air conditioners. Differing from small room air conditioners these products required installation expenses, so Daikin also recruited "professional" air conditioner companies to act as its agents. At the same time, Daikin decided to reduce the share of the large retailers of home appliances from 30 percent to 10 percent. Daikin worked with them in the past as important sales routes, but there were two reasons for the reduction: one, they

mainly sold small air conditioners; and two, their sales tended to be concentrated on a few months in the summer. Daikin realized that those retailers were not fitting for building a sales structure that aimed for high profits. At the same time, Daikin introduced measures to stimulate the sales activities of professional agents by reallocating many employees to the sales field. It could do that because overall sales had worsened due to the effects of the Oil Crisis, causing a large number of redundant employees. Most of those employees were transferred to the sales agents.

Daikin held the top share of the domestic packaged air conditioning market. In 1982, for example, in western Japan, including Osaka, Daikin held a 23–25 percent market share. In Tokyo, though, its market share was only 16 percent, and for the greater capital region, including Tokyo, it was only slightly higher at 18.7 percent. Viewing Daikin in terms of sales regions at the time, therefore, the company had strong characteristics of a local manufacturer serving Osaka and surrounding cities. For that reason, Daikin positioned the capital region as a most important business market to develop, and bolstered its sales capabilities there to include the rapidly expanding chain stores of home appliances, home builders, plants, and offices by relocating excess personnel to the Tokyo branch office and to its sales companies in the Kanto region. It introduced dynamic sales incentives, such as increasing its service cars painted with the same drastic color and inviting representatives of major customers to tour the company's plants. It also held an exhibition of air conditioning equipment at the Science Museum in Tokyo's Kitanomaru Park in November 1985, thus appealing to the company's emphasis on technology. Such active, wide-ranging, and colorful activities served to expand the number of Daikin "fans" among professional air conditioning agents and large companies using air conditioning equipment.

Airconditioning Equipment Exhibition at Science Museum

One result was that the company's market share for the capital region in 1985 rose to 20.6 percent, almost a 3 percent increase over 1982, slightly reducing the market share difference with western Japan. In such ways, Daikin finally succeeded in introducing vigorous sales activities that covered all parts of Japan.

The company's main objectives in rationalizing the activities in its Air Conditioning Production Headquarters were to reduce production costs and respond flexibly to seasonal shifts in production volumes. To accomplish those objectives, Daikin introduced the Toyota Production System into its operations, adjusting it to fit the company's unique situation. That will be discussed in detail later in this history.

In terms of Daikin's product development activities around the time of the First Oil Crisis, meanwhile, supermarkets and other types of chain stores with numerous outlets began developing rapidly in Japan, and the country's first convenience store was opened in 1974. One result was the development and expansion of a new market for commercial-use air conditioners. In 1976, for example, Daikin marketed the G-series of floor-mounted air conditioners aimed for sale at retail outlets and providing integrated functions for substantially reducing costs. The company followed those products in 1978 with development of the K-series of floor-mounted and ceiling-suspended air conditioners, the first

packaged air conditioners fitted with fluorocarbon heat pumps. Developed in-house, the pumps were highly efficient and used fluorocarbon refrigerants. The company sold the products under the brand name "SkyAir". Daikin acquired the "SkyAir" patent in 1970 and it was the first packaged air conditioner to which that technology was applied. Next, in 1980, Daikin marketed a game-changing ceiling-suspended room air conditioner only 19.8 cm wide, fitting it with computer controls to differentiate it from other products. The Electronics Technical Center, established in 1979, contributed significantly toward developing that product's computer control system. Later, market needs shifted toward ceiling-mounted, cassette-type air conditioners, and in 1982 Daikin marketed a ceiling-mounted cassette series that made effective use of technology it previously developed for thin-type air conditioners. In terms of outdoor-mounted equipment, from 1983 Daikin moved toward developing more compact equipment in such ways as mounting a rotary compressor in a small air conditioner. The "SkyAir" air conditioners became hit products benefitting from ultra-thin indoor equipment fitted with a heat pump and controlled by a personal computer. They contributed toward building a solid position for Daikin in the commercial-use air conditioning market.

With the Second Oil Crisis as a stimulus, in June 1979 the Japanese government passed the Energy Conservation Law aimed at promoting more efficient use of energy. Also in 1979, the Ministry of International Trade and Industry (MITI) introduced a major project for stimulating the development of technology aimed at promoting energy conservation. Together with those government moves, industry began moving all out to develop energy-efficient air conditioners. For its part, Daikin developed a superheat pump that used an alternative refrigerant. At the same time, it began developing a multi-room air conditioning for use in buildings, and

tackled the development of new energy-efficient air conditioning systems using medium- and large-size packaged air conditioners. The company's engineers faced many difficult technical problems in developing multi-room air conditioners for use in buildings that connected one outdoor unit with 2 to 20 indoor units. It took them the unusually long period of two and a half years to overcome the many problems that emerged. In the end, the Electronics Technical Center finally developed a system that utilized a compressor with a capacity control for managing multiple indoor units separately and supplying and circulating only the volume of refrigerant they required. Air conditioners that used fluorocarbon as their refrigerant directly moved the heat via the refrigerant. Those air conditioners had outstanding thermal efficiency, and their control system made it possible to cool only the areas needing cooling and only when cooling was needed, thus realizing increased energy savings. Since the heat was directly transferred through the refrigerant, the water circulating pump and air-supply fan in the conventional central systems were no longer required, thus considerably reducing energy consumption.

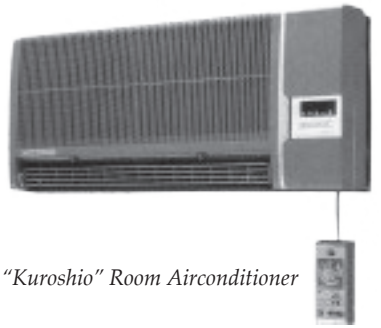
Daikin developed much other game-changing technology as well, starting with a defrosting device boasting of a new mechanism. Air conditioners using fluorocarbon, meanwhile, did not require large-scale installation work, such as air ducts or piping for hot, cold, or chilled water. Piping was also simplified by using only small-size refrigerant piping. Because the air conditioners were ceiling-mounted they allowed full use of available floor space as well. These newly developed air conditioners thus provided many outstanding functions, and they began selling quite well after their introduction in 1982. The new air conditioners won the Daikin President's Award in 1983, and were applauded outside the company for their pre-eminence as energy-efficient products. In that context, the Japan Machinery Federation subsequently awarded the products the prestigious Award for Superior Energy-Saving Machines for 1984. Also in 1984, the products won the Japan Society of Refrigerating and Air Conditioning Engineers' Technology Award.

Conceptual Multi Airconditioning System

After the market came to include small- and medium-size buildings, Variable Refrigerant Volume ("VRV") air conditioners became the mainstay products for increasing the market share of packaged air conditioners. Central air conditioning systems, however, still remained the mainstay products in the medium- and large-size buildings market. In 1983, however, the general building contractor Takenaka Corporation, in charge of the development and design of the first high-rise building in Osaka, approached Daikin with a proposal to install a "VRV" system in that building, which would mark the first time for such a system to be installed in a high-rise building. That was the 32-story Umeda Center Building, the location today of Daikin's Head Office. Many technical problems had to be overcome, of course, before a "VRV" system could be installed in such a high-rise building. Tenants would benefit, however, because individual air conditioning systems meant they would have to pay only for the time they used their system. Since the multi-type system would thus be equitable and match the needs of the time, Daikin decided to tackle the de-

velopment of such a system for skyscrapers by integrating the efforts of its manufacturing, sales, and service divisions. Still, many of the development themes presented tough technical hurdles. Because of the requirement to secure air tightness for such skyscrapers, the demand was especially strong for ensuring a comfortable atmosphere. The overall system included the installation of many sub-units, making it difficult to ensure their reliability. The company also had to develop a new communications system for controlling the system's operation. All these were difficult technical hurdles that had to be overcome. Daikin's engineers applied computer technologies in undertaking this project and developed much new technology in a short period, including wide-range capacity control using an inverter, a newly designed compressor for assuring high reliability, and Direct Digital Control (DDC) communications control. They also developed a construction method for installing air conditioning equipment floor by floor as the building was gradually built, an overall response that also included engineering. Construction of the Umeda Center Building was completed according to schedule in 1987.

The new system applied to construct the Umeda Center Building drew wide attention from the domestic building construction and design industries. Also, over a two-year period after the building opened for business, it attracted about 2,000 general visitors. The new technology Daikin developed and know-how it gained during construction of the Umeda Center Building became the backbone for developing new types of air conditioners one after the other. One of them was the new EX Series of multi-room air conditioners for buildings. The EX Series first sold in 1987 was extremely energy efficient, and offered features not available in past air conditioning systems installed in large buildings, such as permitting great freedom in combining indoor



"Kuroshio" Room Airconditioner

equipment, and allowing easy installation on the construction site. Those various features led to the product's high market evaluation. Sales increased until at one point products in the EX Series accounted for 70 percent or more of all sales of multi-room air conditioners for buildings.

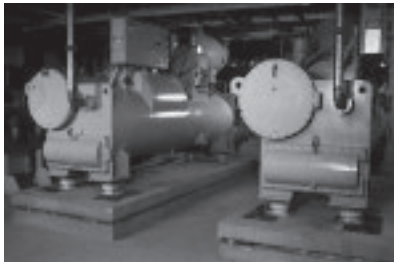
Meanwhile, in terms of room air conditioners, two types sold particularly well in the period after the First Oil Crisis. One was an inexpensive separate type with a wall-type interior unit and the other was a simple integrated window-type unit. From 1979, however, in the context of an increase in energy prices related to the Second Oil Crisis and a cold summer in 1980, the various air conditioning manufacturers developed new types of air conditioners that did not require a backup heater. They also succeeded in developing air conditioners that used an inverter, and generally shifted toward heat-pump types not greatly affected by cold weather. By selling such products, Japan's air conditioning manufacturers realized highly increased energy savings. Around this time, Daikin fell behind other companies in air conditioning technology. In 1981, however, the company switched to the fluorocarbon-heat method and realized a 40 percent decrease in its heating energy efficiency ratio. At that time, the company introduced the highly energy efficient wall-mounted heat-pump type air condi-

tioner called "Kuroshio" (Japan Current). Even "Kuroshio", however, could not compete in efficiency with the products of other companies. Daikin thus introduced an improved version of "Kuroshio" in 1982 that provided 10 percent greater efficiency than the previous product. In the post-Oil Crisis period, the price of kerosene used for heating rose considerably, and "Kuroshio" series of products proved to be highly economical.

In 1983, Daikin developed a recessed type wall-mounted indoor unit. The stimulus for developing that unit was when a Daikin engineer happened to see a wall surface-mounted air conditioner recessed in a wall at the site of a new home being built. Daikin then decided to develop room air conditioners to be installed beforehand in the walls of newly built homes and to use Japanese hemlock, a most fitting material for upscale Japanese-style rooms, as the material for wooden grilles to cover the front of the recessed units. The product took advantage of the installation experience of installers with expertise in air conditioning. The product turned out to be a pioneer product for satisfying consumer needs in the subsequent period of residential air conditioners.

Global Production of Air Conditioners

Even prior to the Oil Crisis, Daikin began expanding its sales network globally. During the 1960s, for example, it built a sales network in Asia, and established Daikin Airconditioning (DAC) in Malta, with sales agents in fifteen European countries. Daikin also established local production operations in Europe and Thailand, and following the First Oil Crisis it also began knockdown operations in several Asian countries. In Singapore, it participated with capital in ACE, Pte. Ltd., in 1976, and began knockdown operations there in 1978. In Thailand, in 1979, the air conditioning sales



Clockwise from top, Celebration with Mayor of Ostend at Opening of Daikin Europe N.V., 350-ton Turbo Air Conditioner Installed in Victoria Station, Victoria Station in London

division of Siam Motors, Daikin's sole distributor in Thailand, was transferred to Siam Daikin Sales Co., thus integrating Daikin's production and sales operations in Thailand. Daikin also began the knockdown assembly of small-size room air conditioners in Indonesia, Malaysia, and the Philippines. The only all-out overseas production base at this time, however, was Daikin Europe N.V. (DENV) in Belgium. DENV took over all Daikin business rights from DAC in Europe, northern and western Africa, and the Middle East, and started in business as Daikin's sole manufacturing and sales base in Europe.

In Europe in the mid-1970s, air conditioners were finally being installed in large buildings. At first there were only a few such buildings being built, and they were fitted with central air conditioning systems. Because Carrier had an overwhelming share of the market for large-scale air conditioning systems, DENV initially emphasized the development and sales of large-size chillers,

even as competition with U.S. manufacturers gradually raised its name recognition. Step by step, it developed a unique market for "VRV" systems (multi-type systems for use in buildings), and succeeded in establishing a monopolistic market share in this tiny market. Even with that success, however, the European air conditioning market was still relatively small, and the economic stagnation resulting from the two oil crises was more serious in Europe than in Japan. It was 1984 before DENV was able to begin steadily earning a profit and finally cover its cumulative losses.

Although the Middle East market for air conditioning equipment expanded rapidly as a result of the oil money that flowed into the area after the oil crises, U.S. companies monopolized the markets. Initially, because the area was part of DENV's territory, Daikin merely monitored the situation. From 1975 onward, however, Daikin began knockdown operations in Iran, Bahrain, the United Arab Emirates, Kuwait, Saudi Arabia, and other countries, thus switching to an aggressive sales policy. In order to strengthen the technical and service capabilities of the local sales and production bases and to provide managerial guidance, Daikin established a training system in 1980 for training and educating local technical personnel, and transferred technicians and other personnel there from Japan.

The U.S. was the world's largest market for air conditioners. And in 1980 Daikin moved ahead of other Japanese air conditioning manufacturers after including entry into the U.S. market as part of its management strategy. In that same year, Hiroshi Fujioka, Managing Director and General Manager of the Overseas Business Division, prepared a sales plan for the U.S. market. The U.S., however, was the world's first air conditioning market, and it was totally different from the Japanese market. Room air conditioners in the U.S. market were all window types, and their prices

were one-third the prices in Japan. The majority of packaged air conditioners were duct-style, split-type units for residential use, and market competition was intense. In those circumstances, Daikin developed a heat pump multi-room air conditioner, and promoted a strategy that targeted mobile homes.

At the time, it was necessary to acquire UL certification in order to sell air conditioners in the U.S. Daikin successfully acquired that certification with consulting assistance from International Energy Systems Limited. In 1981, Daikin established Daikin Airconditioning America Co., Ltd. (DAA), in San Jose, California, capitalized at $100,000. The company then began developing sales offices in cities on or near the West Coast, including Los Angeles, Las Vegas, and Portland. In 1982, Daikin entered into a dealership agreement with Omar Basar, a former employee of Carrier Corporation, who then established Daikin Miami Co., Ltd. (DMI), in Miami, Florida. Next, in 1983, DAA was renamed Daikin U.S. Corporation (DUS), and in 1985 it opened a branch office in Atlanta, Georgia. This entry into the southern part of the U.S. aimed to lay the groundwork for later development of a network of offices throughout the eastern part of the U.S.

In particular, as an indication of its great expectations for expanded sales in the U.S., Daikin invested 30 percent equity in DMI. Payments from DMI to Dakin were frequently late, however, and as sales increased President Basar kept requesting additional assistance. Daikin finally asked for a debt guarantee and sent a vice president in charge of financial affairs to DMI. Basar adamantly refused to disclose financial information, however, and Daikin filed a legal suit requesting that it be allowed to review DMI's financial records. In response, Basar filed for bankruptcy, and sued Daikin and Daikin employees for damages caused by unlawful behavior. That was Daikin's introduction to the legal

suit and countersuit aspects of U.S. society. In the end, Daikin and Basar agreed to an out-of-court settlement. Daikin then paid Basar a sum of money and won back its commercial rights. This "Miami Incident" taught Daikin important lessons related to the fundamental posture it later took in developing its overseas network. The company learned not to enter easily into joint ventures, to choose its partners carefully, and to handle its trade name prudently. It also increased the number of persons handling legal administrative affairs in the Overseas Sales Division and the Archives and Documents Section of the General Affairs Department.

Afterward, as a result of the Plaza Accord of 1985, the yen appreciated greatly and it became extremely impractical to export products from Japan to the U.S. Based only on exports from Japan, Daikin was unable to maintain its competitiveness in the U.S. market because of the intense competition and low price levels. In order to rebuild its business in the U.S., Daikin targeted residential and small-size commercial-use air conditioners as priority areas, and positioned its "SkyAir" heat pump units and multi-room air conditioners as priority products. It also began developing dealers by concentrating on the main urban centers. In the end, however, it was unable to succeed in the U.S. market and again completely withdrew in 1988.

Construction of Rinkai Factory and Kashima Plant

With Japan's high-level economic growth starting around 1955, various Japanese industries became larger in scale. There was also an increase in the construction of industrial parks, and Japan's population, starting with factory workers, became more concentrated in urban areas. One result was the construction of public housing projects one after the other, and of new private residences. Once into the 1960s, urbanization became so rapid that the construction of new housing in the cities could not keep pace with demand. Also, the mixture of factories located next to ordinary residences became a social problem. The living environment deteriorated, including noise and atmospheric pollution, and the worsening of water quality became serious. Enacted in 1967, the Pollution Countermeasures Fundamental Law set strict restrictions on the discharge of waste gases and wastewater from factories. From the mid-1960s, meanwhile, social problems emerged in Japan related to the worsened environment. Besides cadmium poisoning, other serious sicknesses emerged, such as asthma in Yokkaichi. Designating that sickness as environmental pollution finally opened the door for providing medical relief to sufferers.

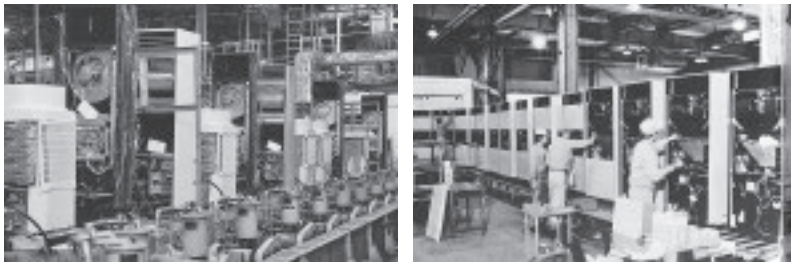
The area around the Sakai Plant when Daikin built it in 1936 was pastoral. Beginning in the 1960s, however, many factories were built in the same area, gradually worsening the local environment. On the other hand, as one response to the shortage of housing in the area, Sakai City bought land from Daikin located adjacent to the Sakai Plant's Founding Works, and from 1966 began building a municipal apartment complex there. From even before that, general housing had been built near the plant and complaints from residents had increased. Daikin prepared in-house countermeasures and responded diligently to satisfy the environmental standards of such industrial areas. The anti-pollution movement grew stronger, however, and in 1969 Osaka Prefecture established anti-pollution regulations much along the lines of regulations the Tokyo municipal government established a few years earlier. In line with the Osaka regulations, many companies, including Daikin, became the focus of surveys of the actual situations surrounding their plants. Discussions were held with local residents, and agreements were reached concerning three main points: 1. operation of the cupola at Daikin's Founding Works

would be halted permanently; 2. within two years the Founding Works and within five years the entire Sakai Plant would halt all operations; and 3. Daikin agreed to compensate the local populace and to pay related medical expenses. In1973, Daikin finally sold the Sakai Plant land to the city and acquired reclaimed land near Sakai Port. With the backdrop of the economic recession accompanying the Oil Crisis around that time, and the delay of soil improvement works, Daikin finally completed construction of the new plant, called the Rinkai ("Seaside") Factory of the Sakai Plant in October 1978. The former Sakai Plant had 50,000 m² of space, but the Rinkai Factory was much larger at 90,000 m². After moving to the Rinkai Factory, Daikin began introducing a new production system it had been studying.

Daikin struggled after the Oil Crisis to rid itself of the Air Conditioning Division's deficit operations. One approach it took was to reduce inventories by shortening production lead time. In response to the increased diversification in customer needs, the number of different models the company offered also increased, making it essential to break from the former large-lot production system. Daikin took particular interest in the new production system Toyota Motor Company had just begun publicizing—the "Just-in-Time" system—and requested assistance from Toyota's Executive Vice President Taichi Ohno, the person most responsible for creating the new system. As a result, Daikin began receiving assistance for introducing the Toyota production system from Senior Managing Director Yasushi Tsuboi of Daihatsu Motor Company, a Toyota Group company.

The Toyota production system Daikin studied at that time later became highly evaluated internationally as a system for producing many parts of many different types on a mixed-model production line. In assembly-type industries it is natural for inventories to increase substantially if assembly is begun after first receiving all the parts. Also, rationalizing each assembly process does not necessarily mean that overall operations will be rationalized. In that context, Toyota landed on the idea of assembling products not by considering the flow of operations from the previous process to the following process but by working backward and having the previous process supply the following process with only the volume of parts it used. This approach resulted in a drastic reduction in inventories. As part of the overall aim of rationalizing the order of assembly operations, the line workers were also trained to be multi-functional or to handle more than one machine, with the aim of averaging out the man-hours of the work per process. The Toyota Production System is called the Just-in-Time (JIT) System because each production process receives exactly the volume of parts it needs at exactly the time it needs them. That was the first time the JIT System was used in air conditioner production, and it was a game-changing innovation. There are relatively fewer parts in an air conditioning system than in an automobile, but there are many more air conditioner models. The production volume of air conditioners also varies considerably by season, unlike automobiles. Daikin thus had to innovate extensively when it fit the JIT System to its production lines.

Daikin employees were transferred to the Head (Ikeda) Plant and Shiga (Ryuo) Plant of Daihatsu Motor Company for training related to the new system. In January 1978, Daikin announced the kickoff date for introducing the JIT System in the Kanaoka Factory of its Sakai Plant. With that announcement, Daikin then began the important task of educating and training its employees to make them more aware that the new system would be able to produce different items on the same line. Mixed production on the assembly lines for small-size packaged air conditioners, called the Pro-



Kanaoka Plant Production Line; Before/After Introduction of PDS

duction of Daikin System (PDS), began in September 1978.

The following month saw construction of the Rinkai Factory completed. Rather than the straight assembly lines previously used for machine processing, Daikin installed U-shaped lines in the Rinkai Factory and each line worker handled more machines than before. From the start, therefore, the new assembly lines were built to match the needs of the PDS. The system for producing compressors was also put into order. From November, the Shiga Plant also began using the PDS. Senior Managing Director Tsuboi of Daihatsu, meanwhile, who originally provided Daikin with PDS guidance, moved to Daikin as an executive advisor. For six years afterward, until 1984, Tsuboi provided important advice and guidance to Daikin related to the new production system.

Among all Japanese companies, Daikin introduced quality control into its operations relatively early. In fact, as early as 1960 the company was already using statistical quality control. But after 1962, the year that the Japan Productivity Center invited Professor W. Edwards Deming to Japan to lecture nationwide about methods of quality control, many Japanese companies studied his approach to quality control. They established QC circles and tackled the matter of using QC methods effectively. Many of the huge volume of products made and exported during the early postwar years in Japan earned a reputation for being cheap and poor in quality, providing grounds for Japan earning a negative export reputation. Energetic QC activities in Japan after Dr. Deming's visit, however, gradually led to much higher quality products being exported. Daikin realized at this same time that in using its previous statistical controls it had not paid sufficient attention to product quality. As one result, it began from 1970 to hold QC Circles at its Shiga, Yodogawa, and Sakai plants with participation by all employees. Next, in 1971 it established monthly QC Promotion Committee meetings. Later that committee was renamed the Product Quality Improvement Committee, with subsidiary organizations in each plant called the Product Quality Improvement Action Committee. QC Circle Committees were also established as organizations for carrying out quality-control activities, with the committee members at all levels acting to improve product quality. Under a unified slogan, and through company-wide technical competitions and Daikin QC Circle Contests, the thinking of all employees, from the bottom up, became directed toward improving product quality.

After the Oil Crisis, the Chemicals Division succeeded in rationalizing its operations thoroughly and developing new technology. In fact, during the difficult period when Daikin's overall revenues were stagnant, the Division increased its profits, thus supporting the company's overall business performance. Sales in the Chemicals Business Division began rising rapidly from 1976, and in 1980 surpassed 200 billion yen, double the sales figure of 1973. Sales in 1983 were triple those of 1973, and in 1985 they were quadruple the sales in 1983, with exports counting for just under 25 percent of the total.

One of the factors that contributed to the rapid growth of the chemical products business was bolstering the R&D Division. Members in that division increased from 145 in 1980 to 236 in 1985.

Facilities were also bolstered, with construction of an applied research laboratory, a processing research laboratory, a polymerization research laboratory, and installation of various types of leading-edge equipment. The division provided a full line-up of PTFE resin products, the mainstay fluororesin products, and Daikin came to rank with DuPont as one of the world's top chemical manufacturers. At the same time, though, competition intensified as Asahi Glass entered the market after establishing a joint venture with ICI (Imperial Chemical Industries, acquired by Akzo Nobel in 2008) of the U.K.

During this period, the Chemicals Division targeted the technological development of molten resins such as FEP, PFA, ETFE, and others. These molten resins are fluororesins that overcome the moldability shortcomings of PTFE and can be easily melted and molded. Daikin developed FEP in 1974 and commercialized it as a resin for covering electric wires. Based on the same technology, Daikin also moved forward with developing PFA that melts at high temperatures and ETFE that melts at low temperatures. In 1982, it was the first Japanese company to market these two resins. Molten resins are highly unreactive, and hardly ever invaded by chemical products or solvents. As a result, the demand for them increased as the market expanded greatly on a global scale for applications mainly for chemical etching semiconductor processes, for pipework and carriers for reactive chemicals in semiconductor manufacturing equipment, and so on. Demand increased globally in response to rapidly growing markets. Daikin improved the properties of fluoroelastomers, meanwhile, such as heat resistance and chemical resistance after the Oil Crisis in response to customer needs, especially in the automobile industry where measures were being introduced to improve fuel efficiency and comply with emission controls. In the process of improving fluoroelastomers,

Daikin developed the iodine migrating polymerization method, block polymers, and the two-stage polymerization method. These technologies were highly rated for their creativeness, and in 1991 the iodine migrating polymerization method won the Japan Patent Office Minister Award from the Japan Society of Inventors.

Daikin also paid close attention to cost cutting. In 1985, it established the Process Development Department, and in 1986 the Engineering Department, thus putting into order a system for developing plant technology at the basic concept stage. Daikin introduced decentralized control using computers in the Gas Production Department from 1980 and in the Resins Production Department from 1982, with both systems subsequently contributing considerably to labor savings and the prevention of errors when operating equipment. Daikin also introduced chemical engineering computational software to raise the efficiency of basic design work, and process simulation software in 1987 to improve the company's engineering capabilities and substantially shorten construction time. That technology had already been introduced in Japan's oil refining and petrochemical industries and its use was expanding, but because the coupling of the molecules of the important substance hydrofluoric acid changes depending on factors such as pressure, temperature, and viscosity, the computational model was complicated. Daikin was the first company to develop it for use in fluorochemical plants.

In these ways, during the period that sales in the air conditioning division were sluggish because the summers of 1980 and 1982 were unusually cold, the Chemicals Division expanded its market by developing new products based on its fluorochemical technological capabilities. Sales of existing products expanded, meanwhile, such as fluorine cleaning solvents and fluororesins, stimulated by the rapid growth of the semiconductor industry. Al-

Kashima Plant

though it became necessary to bolster Daikin's manufacturing capabilities in order to prepare for further expansion in these fields in the future, the Yodogawa Plant did not have enough space for expansion. From around 1970, therefore, the company began searching for a new plant site. The search was postponed for a while following the first Oil Crisis, but management decided a plant had to be built by 1982 and once again began searching for an appropriate site. In 1978, Daikin learned about the Kashima Rinkai Industrial Park being developed along the coast in Ibaraki Prefecture north of Tokyo. There were several other candidate locations as well but after a comparison study was completed Daikin decided in 1980 on a site in the Kashima Hasaki area of that industrial park.

Development of the Kashima Industrial Park began from the early 1970s, and an infrastructure was already in place when Daikin viewed the area, complete with electric power and a nearby port. It was one of Japan's most representative industrial parks. In the central area, Sumitomo Metal Industries had its Kashima Iron Mill, and there were many plants of other Sumitomo group companies. The area where Daikin purchased land included one of Japan's largest ethylene plants and several other plants in the petrochemical industry. It was the first plant Daikin built away from

"Daiflon Solvent"

Plenum Cable using "Neoflon" FEP

the Osaka area, where its business was founded. Daikin was actually fortunate to have found land in such an extremely favorable location. April 1983 saw the start of operations at the Kashima Plant. The first product off the production line was "Daiflon" 22, a product for which demand had expanded quickly. That same November, operations began for producing tetrafluoroethylene and "Polyflon" PTFE M12, and in July 1985 for producing "Daiflon" 113, hexafluoropropylene monomers, and "Neoflon" FEP.