



CREATING A BRIGHTER FUTURE

Toray's 90-Year History

A solid blue vertical bar runs along the left side of the page.

CREATING A BRIGHTER FUTURE

Toray's 90-Year History

Contents

We would like to express our deep gratitude to
Lisa A. Ahart of Toray Plastics (America) Inc.
and Sayuki Kanda of Toray Industries, Inc.,
who cooperated to make this English publication possible.

©2019 Toray Industries, Inc.

Published by
Toray Industries, Inc.
Nihonbashi Mitsui Tower,
1-1, Nihonbashi-Muromachi 2-chome,
Chuo-ku, Tokyo 103-8666, Japan

Edited and Produced by
Shuppan Bunka Sha Corporation
Kanda-Jimbocho, Tokyo / Honmachi, Osaka / Sanno, Nagoya

Printed and Bound by
Nikkei Printing Inc.

Printed in Japan
First Edition March 2019



Introduction	006
Prologue Pre-establishment: Before 1926	008
Creation and Industrialization of Rayon/Mitsui & Co.'s Plans for a Rayon Business/Toward Establishment of a Rayon Manufacturer	
Chapter 1 Toray's Founding and Rayon Business	
Development: 1926-1952	014
Management during the Founding Years (1926-1935)/Management under Wartime Controls (1936-1945)/Postwar Reconstruction and Management (1946-1952)/Industrialization of Nylon	
Chapter 2 Advancement through	
Synthetic Fiber Business: 1953-1970	026
Modernization of Management in a Time of Prosperity (1953-1962)/The Launch of Polyester Fiber Business/A Maturing Market and Management Changes (1963-1970)/Business Restructuring and Company Renaming/Overseas Deployment of Operations Begins/The Launch of Plastics Business	
Chapter 3 Business Restructuring during	
the Structural Recession: 1971-1986	040
The End of Rapid Economic Growth and a Volatile Business Environment (1971-1979)/Looking Ahead to "Toray of Tomorrow" (1980-1986)/Innovation of Fiber Production Technology and Business Restructuring/Development and Reorganization of Overseas Fibers and Textiles Business/Plastics Business Development/Progress and Achievements of New Business Development	

Chapter 4 **Promotion of Group Management and Global Management: 1987–1996** 056

Innovation in Attitudes and Practices, and Management Reform (1987–1991)/Execution of Strategy Looking to the 21st Century (1992–1996)/Strategic Restructuring of Business—Survival and Globalization of Core Business/Aggressive Development of Strategic Business and Cultivation of New Business

Chapter 5 **Great Leaps toward a Highly Profitable Corporate Group: 1997–2006** 070

Business Conditions Fluctuate and Earnings Plummet (1997–2001)/NT Reforms—Transformation into a New Toray (2002–2006)/Aiming to Be Socially Responsible Toray/Transformation into Toray, Leader in Advanced Materials/Development of New Products and New Supply Chains—Joint Development with UNIQLO

Chapter 6 **Reaching for New Heights: 2007–2016** 090

Toray Group Action before and after the Lehman Shock (2007–2008)/IT-II: Reforms with No Exception (2009–2010)/Capital Raised through Public Stock Offering to Advance Growth Strategy/Transition to New Leadership/The Great East Japan Earthquake/Reform and Proactive Management (2011–2013)/Transition to a New Growth Phase (2014–2016)/AP-G 2016 Achievements/Internal Controls and Governance/A Foundation for Sustained Growth—Formulation of AP-G 2019 (FY 2017–2019)/Toward 100 and Then 200 Years

Chapter 7 **Global Business Expansion** 113

Start of Overseas Business Expansion (1955–1970)/Expansion of Overseas Business (1971–1986)/Advance of Globalization (1987–1996)/Rapid Expansion of Overseas Business (1997–2006)/A New Global Expansion (2007–2016)

Chapter 8 **Research and Development** 142

Establishment of R&D Department and Research Laboratories (1927–1959)/Establishment of R&D Divisions and Business Expansion (1960–1984)/Establishment of the Technology Center, and R&D in Growth Business Fields (1985–2001)/From New Toray Reforms to Green Innovation and Life Innovation (2002–2017)

Chronology 172

Toray Group Companies outside Japan 186

Corporate Outline 188

Ghml

1. The content in this book reflects, in principle, the company's state of affairs leading up to the end of March 2017.
2. The names of corporations and organizations provided herein are those used at that time. When a company first appears in the chapter, the official name is used, and its current name may be referred to in parentheses, after which an abbreviated version is used.
3. As for the names of people herein, honorifics are omitted. The job titles are those held by the relevant people at that time.
4. Trademarks of Toray Industries, Inc. and Toray Group companies are enclosed in double quotation marks (" "), and other trademarks in single quotation marks (' '), when they first appear in the chapter.
5. Key words or phrases may be emphasized in italics when they consist of one or two words, and in double quotation marks for three or more words.
6. Numbers are rounded to three decimal places.

Introduction

Toray Industries, Inc. started in 1926 as a manufacturer of rayon yarn. Since that time, we have developed a range of advanced materials, including synthetic fibers, resins, films, and carbon fibers, that met the requirements of each period. We have developed markets, and have developed as a company by expanding our businesses globally. Looking back over the past 90 years, we have experienced many economic and social changes in the business environment, and have continually evolved while adapting to these changes.

With broad acceptance and support of our managerial principles and corporate activities by stakeholders, we achieved consolidated net sales of roughly 2 trillion yen, consolidated operating income of roughly 150 billion yen, and consolidated net income of roughly 100 billion yen during fiscal 2016, the year of our 90th anniversary. During the fiscal year ended March 31, 2017, our total assets amounted to roughly 2.4 trillion yen, we had a total of 255 consolidated subsidiaries and affiliated companies, with 99 in Japan and 156 overseas, and we employed roughly 46,000 people across the Group.

At Toray, we have always focused on the long term as we expanded our production base globally and opened new markets, and we have prioritized research and technology development aimed at creating advanced materials in the pursuit of the ultimate. We firmly believe in the power of the materials, on which all our products are based, to change society. With this in mind, we are working to achieve our corporate philosophy of “Contributing to society through the creation of new value with innovative ideas, technologies and products” so we can take our unwavering position as the world leader in advanced materials.

I hope that reading this history of our company will help you understand that the Toray Group continues to follow our corporate philosophy and the purpose of our predecessors to create a bright future for mankind and society. And to achieve this, we continue to use our wisdom and take on new challenges.



Akihiro Nikkaku
President
Toray Industries, Inc.

Spring 2019



Pre-establishment: Before 1926

Creation and Industrialization of Rayon

While fibers and textiles support our livelihoods and clothes have been used to pass down ethnic cultures, fibers and textiles materials have always transcended national boundaries as an item of trade. Regions that produce natural fibers like silk, cotton and wool are limited and producing nations have achieved growth by exporting them. Other nations' economies have developed, too, as textile industries import and process those raw materials to make products for export.

One prized textile traded in this way was silk, exported from China to Europe via inland and maritime Silk Road routes. Plans were hatched to industrialize silk from early on, but it was not until the second half of the 19th century that chemical technologies were used to create artificial fiber. Rayon was the world's first man-made fiber and, as the term for it, *artificial silk*, shows, it was created as a substitute for silk, which was an expensive yet essential raw material for clothes. Rayon was industrialized at the beginning of the 20th

century and would develop as an industry through to the middle of the century.

Joseph Wilson Swan of the United Kingdom, in 1883, and Hilaire Bernigaud de Chardonnet of France, the following year, both succeeded in the industrial manufacture of a uniform yarn by dissolving cellulose in acid and pressing it through fine holes. This marked the start of rayon production. One after the other, companies were formed for the purpose of producing rayon by one of three methods. But for reasons including cost, it was the viscose method that would dominate. Courtaulds Ltd. of the U.K. became the company with the most successful viscose rayon business.

With the outbreak of World War I in July 1914 and Europe transforming into a battlefield, rayon production across the continent decreased, causing the price in Japan to escalate as imports plummeted. This was the catalyst for the start of domestic production of rayon yarn. Japan's first rayon manufacturer was formed in 1918.

Mitsui & Co.'s Plans for a Rayon Business

Anticipating a jump in domestic demand for rayon yarn, Japan-based general trading house Mitsui & Co. entered an exclusive import and distribution agreement with Courtaulds in 1919, following the conclusion of World War I. Even after that, demand for rayon yarn steadily increased. In 1923, imports came to more than one million pounds (roughly 500 tons), nearly five times more than the previous year. Around 80 percent of those imports were Courtaulds-made rayon procured by Mitsui & Co. Afterward, the price of imports plunged as European manufacturers

dramatically increased production in response to a strong American economy, and so the Japanese government started looking at hiking import duties to protect domestic manufacturers. For Mitsui & Co., the rayon import and distribution business was a vital source of revenue and its sales would take a big hit if import duties were to increase. Internally, they began debating whether to produce in Japan.

The company started forming concrete ideas for domestic rayon production immediately after the Great Kanto Earthquake of September 1923. The central figure among the proponents was leading managing director Yunosuke Yasukawa. Yasukawa believed that if they could arrange a transfer of technology through an alliance with Courtaulds, it would give them a good chance of producing superior rayon yarn. In November 1923, he instructed Mitsui & Co.'s London branch to approach Courtaulds about a technical alliance. Courtaulds, however, was extremely slow to respond.

Meanwhile, ahead of moves to produce rayon domestically, Mitsui & Co. had explored the possibility of entering exclusive distributorship agreements with existing rayon manufacturers in Japan. But coming to

the conclusion it would be hard to make inroads with those companies, Mitsui & Co. reached a decision to establish a new company to manufacture rayon yarn. Yasukawa resolved that (1) a commercial-scale rayon manufacturing company would be established with Mitsui taking a majority stake; (2) the new company would operate a plant on its own under the guidance of foreign



Yunosuke Yasukawa

engineers; (3) the company would enter an exclusive distributorship agreement with Mitsui & Co.; and (4) the company would ask Oscar Kohorn & Co. of Germany to carry out all tasks related to purchasing the necessary machinery and finding foreign engineers.

Toward Establishment of a Rayon Manufacturer

Governance of the Mitsui family (*zaibatsu*; industrial conglomerate) entailed exclusive equity ownership of holding company Mitsui Gomei Kaisha (company), and thereby control over affiliated operating companies, by the Mitsui family. Mitsui Gomei therefore obligated affiliated companies to (1) submit reports on board of directors meetings; (2) hold business briefings prior to general meetings of shareholders; (3) report on financial matters; and (4) seek prior approval of appointments to the board and senior management positions. An even tighter grip was held over the core group companies, which included Mitsui & Co. and Mitsui Mining Co., Ltd. Resolutions on important matters approved by the companies' respective boards of directors were submitted to the board of directors of Mitsui Gomei as matters pending and were not finalized until the Mitsui Gomei board had deliberated on and approved them.

On September 22, 1925, Mitsui & Co.'s board of directors discussed and approved a resolution item proposing the establishment of a rayon yarn manufacturing company. In accordance with Mitsui family rules, the proposal was then submitted as a pending item to the Mitsui Gomei board, which convened four days later on September 26. But despite Yasukawa's efforts behind the scenes to convince chairman of the Mitsui Gomei board, Takuma Dan, and the others, approval was not given at

this time and was put off for the rest of 1925, with there being no record of the topic having been discussed in any subsequent board meeting that year. The proposal eventually received official approval from Mitsui Gomei in the board of directors meeting held on January 13, 1926. The inaugural general meeting of the rayon manufacturing company, which was to be named Toyo Rayon Co., Ltd., was actually held the previous day, meaning Mitsui Gomei's approval came after the fact, following the company's establishment.

The site chosen for the plant had to meet certain criteria, such as having an area of at least 330,000 square meters and being close to a river that could provide a plentiful and stable supply of water of good quality. Sufficient time was therefore set aside to conduct on-site surveys. The surveying trip got underway in June 1925. Sites were surveyed and water quality tests conducted in a total 22 locations over the following three months. After examining a number of potential sites and overcoming various obstacles, the eventual site selected was in Ishiyama district, at the southwest end of Lake Biwa, an area occupied by the village of Ishiyama in Shiga Prefecture. It was land used for both wet and dry rice



Shiga Plant would be built on this site

cultivation and there were no houses in the vicinity at the time. The site was a convenient location for transport of both people and freight to weaving centers in Kyoto and Fukui and there were no problems with the water quantity and quality that could be obtained from the lake. It was considered a prime location for a plant. The purchase of the entire piece of land, with an area of around 480,000 square meters, was completed in April 1926.

In autumn 1925, negotiations for the procurement of machinery and engineers were underway at the London branch. Enlisted to help, Oscar Kohorn picked an Italian, Antonio Minelli, to be chief engineer, while James Reginald Starley of the U.K. and Ernst Koehler of Germany were recommended as heads of manufacturing and engineering, respectively. In order to satisfy the requirements set down by Mitsui & Co., Oscar Kohorn headhunted former Courtaulds employees and gathered more than 20 chemists, engineers and factory hands to make the journey to Japan. Hiring took place in Japan at around this time. One policy of the new company was to rely on foreign engineers for technology and employ new graduates as internal engineers who would be trained.



Antonio Minelli



James R. Starley

Toray's Founding and Rayon Business Development: 1926–1952

Management during the Founding Years (1926–1935)

In the inaugural general meeting of Toyo Rayon Co., Ltd. (hereinafter referred to as “Toray”) on January 12, 1926, Yunosuke Yasukawa, who had been nominated chairman, spoke with conviction as he reported the following in his explanation of the first proposal on the agenda dealing with “matters relating to the company’s founding.”

The development of the rayon industry in the West has been truly astonishing. In Japan, too, the value of rayon imports is climbing, which makes the establishment of rayon manufacturing operations, as we are doing here, enormously beneficial for not only the advancement of our nation’s textile industry, but also the national economy as a whole.

On February 9, Toray applied to the governor of Shiga Prefecture for a permit to establish a plant. It was granted on April 16. Toray observes

the day as its Founding Day. Construction of the plant ran into difficulties, leading to substantial delays in its full completion and start of operations. The ground at the site was soft and large quantities of earth and sand had to be carried in to prepare the foundations. It required the laying of additional railway sidings. But although the main administrative building and living quarters for foreigners were finished in November 1926, the plant buildings, dormitory and company housing were only partially completed by year-end, delaying the start of operations until the following year. The February 1927 suicide of Antonio Minelli, who was in charge of the plant’s construction, was also a major shock to everyone involved.

In May 1927, Asahiko Karashima (later chairman) took up his post as plant manager. Trial operations began in July at the Shiga Plant’s Mill No. 1 following its completion and the installation of machinery. On August 16, the first rayon filament yarn was spun under the direction of Starley, who had taken Minelli’s place as chief engineer. At the Shiga Plant, emphasis was placed on the development of employees’ skills and education of the whole person in line with Karashima’s policy of making the plant “a place for the cultivation of human character.”

In November 1927, Toray commenced sales of rayon to specified dealers across Japan with Mitsui & Co. acting as sole overall distributor. Dealers sold on to the users—weavers and wholesalers. Mitsui & Co. also put effort into export sales, expanding sales channels in mainland China—initially Shanghai—as well as places like Korea, Mexico, and India.

Toray recorded its first profit for a period in the first half of fiscal 1928 and subsequently booked profits in every term. For a time after the

company's founding, no dividends were paid out as priority was placed on strengthening internal reserves. Toray paid out its first dividend (six percent per annum) in the first half of fiscal 1932. At the general meeting of shareholders in July 1933, a resolution to take the company public was approved. As well as allocating new shares to existing shareholders to raise additional capital, 320,000 shares allotted to Mitsui & Co. were put on public offer, with the company listing on Tokyo and Osaka stock exchanges in July 1934.

Management under Wartime Controls (1936–1945)

Germany, transformed into a military-controlled state at the hands of the Nazi Party led by Adolf Hitler, used armed force to annex Austria in 1938 and Czechoslovakia in 1939 before then invading Poland. The United Kingdom and France responded with a war declaration that marked the start of a battle for Europe and lifted the curtains on World War II.

In Japan, young army officers assassinated Lord Keeper of the Privy Seal Makoto Saito and Finance Minister Korekiyo Takahashi in 1936 in the February 26 Incident, which destroyed the effectiveness of civilian control over the military. The following year, 1937, the Japanese military was involved in the Marco Polo Bridge Incident, leading to full-scale war between China and Japan. Then in December 1941, Japan launched surprise attacks on Pearl Harbor in Hawaii, a territory of the United States, and British-controlled territory on the Malay Peninsula, thrusting Japan into an all-out war with the U.S. and the U.K. The outbreak of the Pacific War turned World War II, which until then had been limited to the European theater, into a war of unprecedented scale that pitted the Axis

powers of Germany, Italy, and Japan against the Allied nations, including the U.S. and the U.K.

In December 1936, Toray's first chairman, Yasukawa, stepped down and senior managing director Karashima took over management. The company was without a chairman for roughly a year before Karashima was appointed to the position in December 1937. At the time, Toray's articles of incorporation made no provision for a president and the chairman was the chief executive.

Japan was under a wartime regime in October 1942 when Karashima was appointed chairman of the government-designated Silk and Artificial Silk Control Association and inevitably had to resign as Toray chairman. Succeeding him as chairman was Yosaburo Ito, general manager of Mitsui & Co.'s Osaka branch. Ito was in charge during the tough period up to the end of the war, including a year and a half as president from 1944. Thus, from 1944 onward, right up to the present day, it has been the president who has assumed chief responsibility for management of Toray.

After war broke out between Japan and China in 1937, industrial controls were strengthened. The production and sale of rayon filament yarn, a substitute for silk, were restricted as the product was viewed as



Asahiko Karashima



Yosaburo Ito

a luxury item. Toray management was forced to adapt to wartime controls. With the nation at war, imports of pulp, a raw material for rayon, continued to decline, halving between 1937 and 1941. The rayon industry had also relied heavily on exports. Overcapacity suddenly became all too apparent. Meanwhile, government-imposed restrictions on wool imports from Australia came into force in 1936. From a perspective of resource self-sufficiency, rayon staple fiber quickly attracted interest as a substitute for wool and the government encouraged its widespread use.

Rayon filament yarn had accounted for around 90 percent of Toray's sales at the time, but the controls put in place curbed its production. On the other hand, Toray started producing rayon staple fiber at the Shiga Plant's Mill No. 2 in July 1935 and the volume of production kept increasing. Then in July 1936, Toray established an affiliate, Toyo Kenshoku Company. Construction began on the new company's Ehime Plant (Masaki, Ehime Prefecture; integrated rayon staple fiber manufacturing, spinning, and weaving operations; absorbed by Toray in July 1941) and operations began as soon as the work was finished in April 1938. Toray also built a spinning and weaving mill on land in Seta, Shiga Prefecture, where Toyo Kenshoku had abandoned construction of a rayon staple fiber plant in part due to opposition from the Lake Biwa fisheries union.



Ehime Plant of Toyo Kenshoku (1941)

The Seta Plant started operating in February 1938.

In July 1941, Toray absorbed Shonaigawa Rayon Company and K.K. Shonaigawa Dye Works, which were initially established as separate companies, and merged them as the

Aichi Plant. But in December of that year, all machinery and equipment were requisitioned by the government. In the context of the Pacific War, Toray was not a supplier of munitions and was therefore forced to relinquish its equipment as a source of steel. To be able to maintain a certain amount of equipment, Toray inevitably had to produce items for military use.



Shiga Plant damaged by bombing (July 1945)

As of the end of 1936, a decade on from the company's founding, the workforce numbered 7,832 employees (7,827 at the Shiga Plant, five at Tokyo Head Office), but by the end of 1941, the year the Pacific War began, there were 10,164 employees. The number subsequently declined, falling to 6,750 by the close of 1945, when the war was over. The United States had started bombing industrial centers on mainland Japan in June 1944 and by 1945 even private homes in urban areas were bombed indiscriminately. In May 1945, the Aichi Plant was partially destroyed by fire as a result of an air raid and the Shiga Plant was bombed in July. Casualties at the Shiga Plant came to 14 dead, 50 severely injured, and a little over 200 mildly injured.

Postwar Reconstruction and Management (1946–1952)

In Japan, the anniversary of the end of the war is a commemoration of August 15, 1945, but in many other countries, September 2 is recognized as the day that World War II came to an end and commemorated as an

anniversary of either the war's end or victory in the war. Japan conveyed its acceptance of the terms of the Potsdam Declaration to the Allies on August 14. The following day, August 15, a speech read out by Emperor Hirohito was broadcast over the radio. It was a declaration of Japan's defeat directed at the nation. September 2 was the day that representatives of the Japanese government and armed forces signed the instrument of surrender aboard the USS Missouri in Tokyo Bay.

At the direction of the General Headquarters of the Supreme Commander for the Allied Powers (SCAP), *zaibatsu* (industrial conglomerates) were dismantled; laws were enacted to prohibit monopolies and eliminate excessive centralization of economic power; bold agricultural land reform was implemented; three labor laws were enacted—the Labor Union Act, Labor Relations Adjustment Act, and Labor Standards Act; and educational reforms were implemented, extending compulsory education from six to nine years. In this way, social and economic infrastructure for postwar Japan was laid. In 1949, a single exchange rate of 360 yen to the U.S. dollar was introduced and tax system reforms were implemented in line with recommendations made by a mission on taxation headed by Carl Sumner Shoup.

Democratization of the Japanese economy began with a November 1945 SCAP directive ordering the dissolution of the “big four zaibatsu”—Mitsui, Mitsubishi, Sumitomo, and Yasuda. Mitsui & Co., Toray's parent company, was disbanded in July 1947 in line with the Enterprise Reorganization Act.

In November 1945, Shigeki Tashiro became president, succeeding Yosaburo Ito. The dissolution of parent company Mitsui & Co. had a number of implications. First of all, securities companies and other

financial institutions became major shareholders. Toray had also lost its sole distributor (Mitsui & Co.), unchanged since the company's founding, and thus faced the need to put in place its own independent distribution system.

Toray resumed production, concentrating rayon filament yarn operations at the Shiga Plant and rayon staple fiber operations at the Ehime Plant, but it would take a number of years before full-scale production could be achieved. In May 1947, the company set up the Commercial Department in Osaka as an organization for carrying out independent distribution activity.

Around this time, SCAP issued a directive purging several people from public office, who had served as executives during the war years, including Tashiro, Karashima, and Ito. Tashiro resigned from Toray at the end of June 1947. His replacement, in charge of management, was managing director Kikuo Sodeyama, who became president in July 1948. Sodeyama was among the initial group of university graduates hired in 1926 at the time of Toray's founding. Tashiro later had his purge lifted and he returned to the Toray Board at the extraordinary shareholders meeting in March 1950. He was appointed chairman.

Taking over from Tashiro, President Sodeyama advocated a fundamental management philosophy of “building up human resources at the



Shigeki Tashiro



Kikuo Sodeyama

same time as making products.” While adopting modern American-style management methods under SCAP guidance, Sodeyama attempted to integrate them with the style of human resources development Toray had followed since its founding. The number of employees steadily increased, reaching 15,220 by the end of 1950.

Immediately after the war, there was a need to expand business addressing private-sector demand to accommodate those returning from military service. On hearing a lecture by Dr. Jackson W. Foster, an authority on penicillin research, President Tashiro could sense the potential. At Tashiro’s invitation, Dr. Foster visited the Shiga Plant in December 1946 and recommended manufacturing penicillin using deep-tank fermentation. Toray commenced research in January 1947, at the same time installing a pilot plant consisting of two 300-liter tanks and launching the first culture.

However, the number of penicillin manufacturers subsequently increased and Toray, originally a fibers and textiles company, would have had to carve out new sales channels to engage in the business. Mutual benefits for other businesses were also meager. Unable to foresee any way to withstand the competition, Toray stopped production of penicillin in 1953. At that time, senior management had already made a decision to industrialize nylon fiber.

Industrialization of Nylon

In October 1938, the U.S. firm E. I. du Pont de Nemours and Co. (DuPont) announced that it had successfully developed a polyamide-based synthetic fiber, which it was calling *nylon*. The words DuPont used to draw attention

to nylon were sensational in themselves—made from “coal, water, and air,” the fiber was “as strong as steel, as fine as the spider’s web.” Marking the true dawn of the synthetic fiber age, nylon came as a shock to not only Toray’s leadership, who had envisaged rayon fiber at the forefront of a new age, but textile circles all over the world. The inventor of nylon, Wallace H. Carothers, had led the life of an academic as an instructor at Harvard University until he joined DuPont and invented the polyamide fiber (nylon 66) in 1935.



Wallace H. Carothers, inventor of nylon

Shortly after DuPont’s nylon announcement, samples of the fiber arrived in Japan from the New York branch of Mitsui & Co. Researchers at Toray used the samples in their nylon 66 research and succeeded in melt spinning the fiber on December 27, 1939. They also embarked on research into a polyamide formed from caprolactam—nylon 6—and in May 1941 succeeded in melt spinning this fiber, too. In October 1942, Toray gave it the name “Amilan,” registering it as a trademark. Equipment was put in place to trial small-scale commercial production and, in December 1942, Amilan was made available on the open market with emphasis, from a food security point of view, on its application as fishing line for use by fisheries. In October 1945, soon after Japan’s defeat, Toray resumed production at the Shiga Plant using Amilan monofilament facilities. Production had stabilized by June 1947 when the company launched a fishing line trademarked as “Ginrin.”

In 1946, a textile mission to Japan by Allied powers visited the Shiga Plant and, on seeing Amilan, pointed out that the fiber might



Signing of the patent licensing agreement with DuPont (June 1951)

infringe on patents owned by DuPont. Amilan was indeed nylon 6 and even though the manufacturing process and substances differed from the nylon 66 produced by DuPont, there was potential for infringement if peripheral patents relating

to processes from spinning onward were included. Toray management believed the wise thing to do would be to enter a technological alliance with DuPont and dispel fears of a patent war. Negotiations began, and in November 1950, DuPont notified Toray of its consent and terms for a technological tie-up.

The talks with DuPont progressed and in June the following year, 1951, a patent licensing agreement was signed by Shigeaki Tashiro for Toray and Wendell R. Swint, head of the foreign relations department at DuPont, at the latter's headquarters in Wilmington, Delaware of the U.S. The terms of the agreement were payment to DuPont of a three percent royalty on sales, including a three million U.S.-dollar (1.08 billion yen) advance, and a duration of 15 years. The advance was nearly 1.5 times Toray's capitalization at the time, which was 750 million yen. Negotiations resulted in the amount being paid in five installments.

Amid the extreme shortage of materials after the war, the fibers and textiles industry experienced a rayon boom and successive chemical fiber producers moved to expand their rayon staple fiber capacity. Toray, however, channeled a disproportionate amount of management

resources into commercializing and expanding nylon production in anticipation of future growth. It was because of this that Toray managed to escape the industry slump that came later as a result of rayon staple fiber overcapacity and alone enjoyed high levels of profit generated by nylon business growth.

In May 1950, as a site for a caprolactam (nylon 6 raw material) and polymerization plant, Toray purchased part of the former premises of the Oye Plant of Mitsubishi Heavy Industries, Ltd., which was close to Toagosei Chemical Industry Co., Ltd., a supplier of raw materials such as cyclohexane, ammonia, and sulfuric acid. It was designated the Toray Nagoya Plant. In July, ground purification ceremonies were held for both Nagoya and Aichi plants and construction got underway. Aichi Plant spinning facilities were completed in February 1951 and the first nylon filament was produced. The Nagoya Plant followed suit, commencing nylon staple fiber production in December.



Nagoya Plant (1951)



A bird's-eye view of Aichi Plant (1952)

Chapter 2

Advancement through Synthetic Fiber Business: 1953–1970

Modernization of Management in a Time of Prosperity (1953–1962)

Japan's postwar economy recovered with staggering speed and charged into a period of rapid growth from 1954. Driven by an investment boom, the Japanese economy experienced two major periods of prosperity, known as the Jimmu Boom (1954–1957) and the Iwato Boom (1958–1961). At Toray, managing director Hirosaburo Mori replaced Kikuo Sodeyama as president in March 1960.



Hirosaburo Mori

As a result of having launched a full-scale nylon business, Toray's companywide profit turned up in fiscal 1953 and kept rising until fiscal 1957. In fiscal 1955, the company had the highest net income among all listed companies in Japan, propped up by strength in both rayon and nylon fiber businesses.

In March 1955, Toray officially established its Company Principles, thereby

Company Principles

Toyo Rayon contributes to communities

For consumers,
better products at lower prices

For employees, a stable life

For shareholders, fairer dividends



Inaugural presentation ceremony of the Toyo Rayon Science Foundation (March 1961)

documenting managerial principles that had been passed down since the company's founding. "Toyo Rayon contributes to communities." This management philosophy, which positioned the company as a public institution existing for the benefit of society, expressed a noble and progressive stance that mirrored the heightened awareness of corporate social responsibility (CSR) that would come later. At the same time, it was a commitment to fulfill Toray's responsibility to stakeholders, namely consumers, employees, and shareholders.

As a way of giving form to the philosophy behind the company principles, Toray set up the Toyo Rayon Science Foundation (now the Toray Science Foundation) with an endowment of one billion yen, receiving authorization from the relevant authority in June 1960. With the objective of assisting and encouraging science and technology, the foundation was to provide grants for basic research in the fields of science and technology and confer awards in recognition of outstanding scientific achievements.

From the mid-1950s through to the early 1960s, it was the nylon 6 fiber and textile business that generated the bulk of Toray's operating

revenue. Although nylon accounted for 35 percent of total sales in fiscal 1953, well short of the 62 percent from rayon, the contribution from nylon increased steadily to overtake rayon and peaked at 70 percent in fiscal 1957. The following year, fiscal 1958, sales of polyester fiber began, and in fiscal 1962, nylon accounted for 52 percent of sales, polyester for 33 percent, and the share from rayon fell as low as eight percent.

In September 1958, the Aichi Plant was capable of producing 50 tons of nylon filament yarn daily, and the Nagoya Plant, 15 tons of nylon staple fiber, for a total capacity of 65 tons, but there was no room for any further expansion at either plant. Construction therefore began on a new filament yarn plant in Okazaki City. The basic concept for construction of the Okazaki Plant was that the resulting facility had to be one of the world's most advanced. Technology surveys were even carried out in Europe and the United States. The plant was officially opened at a ceremony on March 10, 1960. Work also began on a new filament yarn facility at the Shiga Plant. It was finished in October 1959.

A new method for manufacturing nylon 6 raw-material caprolactam—photo-nitrosation of cyclohexane (PNC)—was developed independently by Toray based on basic research undertaken by Yoshikazu

Ito (later president). In September 1960, almost a decade after the research officially began, a pilot plant was established and, in March 1962, equipment for an initial phase of quasi-mass



Okazaki Plant (1960)

production with a five-ton daily capacity was completed inside the PNC facility at the Nagoya Plant.

The Launch of Polyester Fiber Business

In June 1952, Toray decided to prioritize polyester in establishing a second synthetic fiber business. Polyester fiber was effective for pleat retention and crease recovery and those notable properties could be brought out even when blending polyester staple with a natural fiber and without losing the natural fiber's texture and feel. The researchers moved their research into industrialization of the polyester fiber they called *F-III* (*Fiber III*), in reference to its following after rayon and nylon, into full gear. In July, Sodeyama visited the British firm Imperial Chemical Industries Ltd. (ICI) to kick off negotiations with a view to introducing some of their technology. A series of talks were held, but around the same time, competitor Teikoku Jinzo-Kenshi Kaisha, Ltd. (now Teijin Limited) had also approached ICI about a technological alliance.

On December 8, 1955, ICI indicated that it was willing to grant both Toray and Teijin licenses of identical status, asking a licensing fee of 100,000 pounds (approx. one billion yen) for both companies combined and allowing royalties to be based on the combined sales of the two companies.



Signing of the technological alliance agreement with ICI (February 1957)

The offer presented relatively relaxed terms compared to other such tie-ups at the time and so negotiations centering on joint introduction of technology by the two companies progressed quickly. In January 1957, ICI director in charge of fibers and plastics, Peter C. Allen, arrived in Japan and the trio of Allen, Toray's President Sodeyama and president of Teijin, Shinzo Oya, signed a written agreement on February 7.

Toray identified potential sites for a new plant to manufacture polyester fiber and settled on a site straddling both Mishima City and the village (now town) of Nagaizumi in Shizuoka Prefecture before purchasing 330,000 square meters for the intended premises. Construction work began in May 1957. Production commenced the following March on completion of facilities for both staple fiber and filament yarn. This was Japan's first commercial-scale operation for the production of polyester fiber. Work subsequently began on construction of a polyester staple fiber mill on Ehime Plant premises. It was completed in January 1963.

On the sales front, too, Toray started out by looking for customers that the company itself could team up with on product development. Initial product development involved a great deal of trial and error, but



Mishima Plant (1959)

the collaborative activities gave birth to a wide range of goods for daily life, as well as knitted and woven fabrics for use in clothing. Polyester products gradually came to be used more by

consumers. In this way, production and sales alliances broadened their reach. In May 1959, new expressions were adopted in place of *production alliance* and *sales alliance*—"Toray Production Team" (PT) and "Toray Sales Team" (ST).



Newspaper ad for Toray Tetoron (1958)

Prior to putting polyester fiber on the market, Toray and Teijin jointly called for suggestions for a trade name in April 1957. An advertisement with the copy, "Give me a name," drew a huge response, fielding more than 100,000 submissions. A selection panel was formed to pick the winning entry, *Tetoron*. Toray and Teijin proceeded to deploy the respective trade names, "Toray Tetoron" and 'Teijin Tetoron,' in subsequent promotional campaigns.

A Maturing Market and Management Changes (1963–1970)

The years 1964 and 1965 were marked by what became known in Japan as the *securities recession*, but in the textile industry, it was called the *nylon recession*. It had a severe impact on Toray, which had been enjoying high levels of profit as a first mover in the synthetic fiber business. Ordinary income fell 37 percent between fiscal years 1964 and 1965, from nine billion yen to 5.7 billion yen.

To cope with the worsening slump, Toray curtailed operations, while also making plans to stand down employees and restrict hiring. Alongside

cancellation and reduction of new employee signings, all-out efforts to improve efficiency were continued. A series of measures, including temporary transfers to other companies and the mass secondment of 2,200 employees to newly established subsidiary Toray Engineering Co., Ltd., resulted in a 15 percent downsizing of the workforce over five years from its peak of 28,123 employees in March 1965 to 23,840 in March 1970.

In November 1966, as the company was starting to get back on its feet in the wake of the recession, Hirosaburo Mori, who had been president throughout this period, was replaced by Executive Vice President Seiichiro Hirota. Hirota charted Toray's new course, calling for enhanced international competitiveness and a stronger corporate structure.

The Japanese government responded to the recession with a major boost in spending that, combined with export growth stemming from economic expansion in the United States, resulted in the economy picking up again from November 1965 as it entered the Izanagi Boom, which lasted until July 1970.

Meanwhile, U.S. President Richard Nixon, who was inaugurated in January 1969, made it known that he believed import restrictions should be placed on textiles. The U.S. government then started pressing Japan to sign a bilateral agreement. The Japanese textile industry came together to form a council to address issues concerning textile exports to the U.S. (named the Japan Textile Federation in January 1970) and through it organized a movement opposing the restrictions. But in a summit between the



Seiichiro Hirota

leaders of the two countries in November 1969, as would later be made public, Prime Minister Eisaku Sato made a secret pact with President Nixon that was likened to “using thread to buy rope” in reference to his acceptance of restrictions on textile product exports to the U.S. in return for the reversion of control of Okinawa to Japan (Okinawa is written using the character for rope). The two governments signed a provisional bilateral agreement in October 1971.

Internally, there was growing sentiment toward industrialization of acrylic fiber as a third synthetic fiber after nylon and polyester. With a view to commercializing acrylic fiber using its own technologies, Toray resumed full-fledged research into *F-IV (Fiber IV)* at the Central Research Laboratories. In July 1959, a quasi-production facility with a daily acrylic staple fiber production capacity of three tons was completed at the Nagoya Plant. Prior to this, in May, Toray had settled on “Toraylon” as the trade name, but because the company was a latecomer to the business, it sought to streamline manufacturing by completing a continuous polymerization process. Toray also decided to centralize production at the Ehime Plant, setting up an acrylic staple fiber manufacturing facility with a capacity of 15 tons per day. Operations were launched in March 1964, with sales beginning around the same time. The facility at Nagoya was also transferred to Ehime in July.

Furthermore, in March 1961, Toray was extended a sublicense by Mitsui Chemical Industry Co., Ltd. relating to the introduction of polypropylene fiber technology of Italy's Montecatini Chemical & Mining Company. In July, Toray and other sublicensees, Toyobo Co., Ltd. and Mitsubishi Rayon Co., Ltd., jointly settled on a common trade name, “Pylon.” However, Pylon's drawbacks in terms of properties such as



Signing of the agreement on establishment of Toyo Products (February 1963)

it had developed and industrialized ‘Lycra,’ a polyurethane fiber called spandex (elastic) fiber, Toray started sounding out DuPont about introducing technology with an eye to commercialization. DuPont, however, expressed a desire to proceed with commercialization through not a technology license, but a joint venture. The two companies exchanged a memorandum of understanding relating to the establishment of a new company in October 1962. In November, the trade name “Opelon” was decided, and in February 1963, Toray and DuPont entered agreements relating to establishment of a new company and technological assistance. In keeping with foreign capital law, a 50-50 joint venture was approved in December. It was established as Toyo Products Co., Ltd. (now Du Pont-Toray Co., Ltd.) in June 1964. This particular business is currently run by Toray Opelontex Co., Ltd., which markets under the Lycra brand.

Business Restructuring and Company Renaming

In April 1961, Toray decided on, and put into action, a policy to phase out its rayon filament business, entailing the gradual dismantling of related

dyeability were not easily overcome. In 1965, Toray resolved to wind down business relating to apparel applications and brought an end to related research and development in 1966.

Then in 1959, following DuPont’s announcement that

facilities between September 1961 and May 1963. The state of rayon staple operations was also debated, but at that time Toray had nothing to replace the product with and the course chosen was to seek profitability improvements through the development of speciality products. However, profitability improvements did not come to pass. Toray ended its rayon staple production in May 1975.

From the 1960s, Toray aggressively pursued new product development. The company constructed a plant in Gifu Prefecture (now the Gifu Plant) to produce artificial leather that looked and felt like real leather. Monthly capacity was 30,000 meters. However, commercialization in the shoemaking domain did not progress well and therefore fundamental improvements to business were explored. Set a deadline of two years, researchers were spurred into activity and out of all their efforts a product took shape. The artificial leather, fabricated from bundles of ultrafine fiber, was reported as being extremely similar in appearance and texture to materials such as deerskin, but performed better than natural leather in terms of the physical properties of uniformity, dyeability and launderability. Until then referred to by its test code, XL-223, the artificial leather was given the name Toray-223. It was



Rayon filament yarn—the final thread cut (1963)



Paris haute couture show (July 1970)

given a spectacular entry onto the world stage, used by six top fashion designers in their 1970 Paris haute couture collections for the autumn/winter season.

Meanwhile, deliberations were underway regarding changes to the company name and its articles of incorporation given that the winding down of the rayon filament business in 1963 had created inconsistency between the name of the company—Toyo Rayon Co., Ltd.—and the activities it actually engaged in. Criteria considered in the selection of a new name included that it should be consistent with the company's direction for development, and that people at home and abroad should find it easily recognizable and easy to become attached to. From a number of options on the table, "Toray Industries, Inc." was selected as the new name. The company was officially renamed on January 1, 1970.

Overseas Deployment of Operations Begins

In 1955, Toray established trading company Trilon Co., Ltd. in Hong Kong, its first overseas operation involving a capital contribution. The move came on the back of a determination that if Toray wanted to capture a competitive position in the Hong Kong market, which at the time was the biggest textile center in Asia, it needed its own sales company, rather than rely solely on the local branch of a general trading house. Trilon, by expanding operations in a tie-up with a local sewing enterprise, set a precedent that would be followed as the Toray Group's overseas trading network took shape during the 1980s.

In the 1960s, Toray responded to import substitution industrialization policies adopted by developing nations by actively moving to set up

local corporations as joint ventures, deploying business in partnership with trading firms. The first full-scale manufacturing joint venture was Thai Toray Textile Mills Co., Ltd. (now Thai Toray Textile Mills Public Co., Ltd.; TTTM)



TTTM (Thailand)

in Thailand. TTTM took on the "GOLDEN EAGLE" brand of polyester/rayon blended fabric that Toray had been exporting and locally undertook integrated manufacturing of the products from spinning through to weaving, dyeing, and finishing, as well as sales.

The Launch of Plastics Business

Toray commenced sales of nylon 6 resin in March 1953, but as a nylon molded material, its supply was limited to specific users. Come the late 1950s and a number of new nylon resin manufacturers entered the fray. The heightened competition pushed prices down, at the same time expanding applications, increasing demand. From that point on, Toray was constantly expanding facilities and increasing production.

In December 1960, Toray established an independent division for its plastics business, aiming for concerted administration of production and sales functions. The fact that 20 to 30 percent of total R&D investment around 1965 was channeled into plastics, even though plastics business accounted for no more than three to four percent of total sales, was an



Chiba Plant

indication of management's intention to develop plastics as a future core business.

In February 1963, Toray attached the trade name "Toyolac" to its ABS resin and

commenced sales of the product in March. In February 1964, a production facility was completed at the Nagoya Plant, where monthly production increased to 600 tons by 1967. With demand predicted to keep rising, construction began on the Chiba Plant in July 1969. The new plant went online in July 1970. As a latecomer to the business, Toray struggled on quality and distribution fronts, but sales promotion activities eventually bore fruit as major applications were found in the automotive field. Production of nylon 66 resin, meanwhile, got underway at the Nagoya Plant in 1965. Nylon 66 was to exist alongside nylon 6 and likewise be developed into a full-scale business.

Polyester film products were launched first by ICI in 1953, as 'Melinex,' and the following year by DuPont, as 'Mylar.' The films were imported to Japan, drawing attention with superior characteristics not possessed by existing film materials. While advancing research into the industrialization of polyester fiber, Toray also conducted a basic examination of the future potential of a polyester film business and related production technology. Research into polyester film industrialization began in 1957.

Equipment was installed in a corner of the Mishima Plant in October 1959 and trial production got underway. Electric appliance manufacturers

and other were approached for their evaluation. As quality was deemed to be no inferior to Mylar, sales began in March 1960 with "Lumirror" settled on as a trade name.

Lumirror production began in 1963 at the Shiga Plant following the transfer of facilities from the Mishima Plant. Production increased between 1967 and 1969 and a decision was made to construct a new plant. Toray purchased a 130,000-square-meter site from Gifu Prefecture, formed the Gifu Plant and began Lumirror production there in July 1971. The Mishima Plant also embarked on full-scale production of Lumirror in October 1982.

Polypropylene film trial production began at the Mishima Plant in February 1962 and sales under the trade name "Torayfan" began in July. Mass production commenced at the Shiga Plant in June 1963 and at the newly established Tsuchiura Plant in October 1970. In addition, Toray established technology for producing cross-linked high-expansion polyethylene sheet, with "Toraypef" as the trade name. Trial production got underway at the Shiga Plant in April 1966. Demand for Toraypef as a molded packaging and container material was predicted to jump and a mass production facility was completed in September 1968.



Gifu Plant groundbreaking ceremony (June 1970)

Business Restructuring during the Structural Recession: 1971–1986

The End of Rapid Economic Growth and a Volatile Business Environment (1971–1979)

In August 1971, President of the United States Richard Nixon announced urgent measures to combat his country's trade deficit, including a halt to convertibility of the U.S. dollar to gold. The Nixon shock resulted in the collapse of the Bretton Woods system that had established the gold-dollar standard, and the dollar weakened against a stronger yen.

Japan's economy recovered in 1972 with the help of a government economic stimulus package, and inflation gradually gathered pace due to factors including a boom triggered by efforts by the cabinet of Kakuei Tanaka to “remodel the Japanese archipelago,” as well as a global rise in prices for primary products. With aggregate demand expanding, the market soared remarkably in early 1973. In February, Japan switched to a floating exchange rate for the yen, which appreciated to the 270–279 yen range against the U.S. dollar.

In October that same year, the Organization of the Petroleum Exporting Countries (OPEC) raised oil prices, causing the first oil crisis. Consumption immediately cooled, and stagflation occurred, marked by simultaneous price increases and economic slowdown. In 1974, Japan recorded its first year of negative growth since the end of the war.

In the fibers and textiles industry, exports came to be restricted by bilateral agreements as a result of the signing of a Japan-U.S. textile agreement in January 1972 and the multilateral Multi-Fiber Arrangement (MFA), which followed. It was a period when export-centric strategies for growing business were hard to implement. Toray, which had booked its highest earnings ever in fiscal 1973, suffered sales and profit contraction in fiscal 1974 and in fiscal 1975 recorded its first ordinary loss since the founding period. An ordinary loss was booked again in fiscal 1977.

The person in charge of Toray during the 1970s, and therefore tasked with navigating a volatile business environment, was President Tsuguhide Fujiyoshi. In November 1971, then vice president Fujiyoshi took up his position as president, and at the same time Kizo Yasui, who had also been



Tsuguhide Fujiyoshi



Kizo Yasui

vice president, became chairman. The management policy presented by Fujiyoshi had two tracks—revitalization of the synthetic fiber business and diversification of businesses other than fibers and textiles. It was the first time Toray’s chief executive had introduced a policy of diversified business management.

During the 1960s, Toray had built a system for supplying its own raw materials for synthetic fiber. Around 1970, the company was already producing in-house all of the caprolactam it used to make nylon 6, as well as 90 percent of the dimethyl terephthalate (DMT) and all of the terephthalic acid (TPA) it used as raw materials for polyester. As for acrylonitrile, a raw material used for “Toraylon” acrylic fiber, 70 percent of the required amount was sourced through an affiliate. Toray also had systems in place for supplying its own raw materials, with the Kawasaki Plant able to provide cyclohexane and paraxylene, used to make caprolactam and DMT/TPA. However, the premises for doing so were completely undermined by high oil prices stemming from the two oil crises in 1973 and 1979, and ongoing appreciation of the Japanese yen.

To ensure that it had appropriate control over the cost of its products, Toray shifted to a materials policy that did not insist on self-supply. In April 1983, a purchasing and logistics division was established and progress on streamlining operations was sought through procurement from outside sources. At the same time, Toray adopted a plan to advance joint operations with raw material supplier Nippon Petrochemicals Co., Ltd. In 1983, having made progress on downsizing facilities and the workforce, the Kawasaki Plant started out afresh as Ukishima Aroma Co., Ltd., a 50-50 joint venture with Nippon Petrochemicals. Toray transferred its shareholdings in Ukishima Aroma to Nippon

Petrochemicals in 1987, thus bringing an end to its raw material production operations.

Looking Ahead to “Toray of Tomorrow” (1980–1986)

In June 1980, Fujiyoshi moved aside to become chairman and Vice President Masao Ikawa took over as president. However, Ikawa met with misfortune as he was taken ill within half a year of taking up the position and he had to step down. He was succeeded by Yoshikazu Ito, who became president in January 1981. Ito stressed that Toray had to win in the market and, saying that marketing and R&D went hand-in-hand, worked to define a management outlook for the mid- to long-term, for example through the formulation of a long-term management vision and strengthening of marketing development capability.

On September 22, 1985, finance ministers of G5 nations (the U.S., the United Kingdom, West Germany, France, and Japan) met at the Plaza Hotel in New York with the goal of correcting an overvalued U.S. dollar and agreed, among other matters, that an orderly appreciation of major currencies against the U.S. dollar was desirable. This was the Plaza Accord. The value of the U.S. dollar began its decline right away and



Masao Ikawa



Yoshikazu Ito

one year later was trading in the 150 yen range, compared to 240 yen immediately prior to the agreement. The rise of the yen created a tough business environment for Japanese export industries, but on the other hand it spurred a spree of purchasing of U.S. assets with Japanese capital and a boom in overseas travel by Japanese people. For Japanese manufacturers, it led to an increase in overseas production. Because the Korean won and Taiwanese dollar appreciated alongside the yen, textile products from Asian newly industrialized economies (NIEs)—Korea and Taiwan—which had replaced exports from Japan to the U.S. and Europe lost their competitiveness. Southeast Asian (primarily ASEAN) nations suddenly emerged as an origin for textile exports to western markets.

At around that time, Toray was advancing its third mid-term business plan that would take it through to fiscal 1986, the year of its 60th anniversary. Under the banner Challenge 60, the plan was to carry out aggressive capital investment like never before, to the value of 150 billion yen over three years. As group-wide priorities to be addressed over the three years, projects such as strengthening of corporate structure,

Corporate Philosophy	Contributing to society through the creation of new value with innovative ideas, technologies and products
Management Policy	<ul style="list-style-type: none"> • Put people center stage • Generate market-inspired ideas • Grow with the times
Toray Motto	Fostering trailblazers to take us even further <ul style="list-style-type: none"> • Visit customers more • Focus on goals more • Be more interesting • Visit operations more • Be more persistent

involving modernization of filament yarn facilities, were complemented by the formation and launch of a corporate identity (CI) project.



New corporate symbol

During 60th anniversary commemorations on April 16, 1986, the company announced its Corporate Philosophy and Management Policy, the Toray Motto, and a new corporate symbol. The quotation marks in the symbol represent elements such as dialogue and standing out.

Innovation of Fiber Production Technology and Business Restructuring

At the end of 1981, Toray set up a project to modernize operations relating to filament for apparel use in order to develop next-generation yarn manufacturing technology. Central to the project was the development of new technology for manufacturing yarn revolving around the creation of a one-step process based on high-speed spinning, elimination of breaks (called ZB; *Zero Breaks*), and automation.

In April 1984, a decision was made to build a nylon filament yarn facility at the Ishikawa Plant, which had started out as a polyester filament yarn factory in June 1975. The nylon filament yarn



Ishikawa Plant's new nylon filament yarn factory (1985)

facility went online in August 1985 as a state-of-the-art plant replete with the latest technologies and facilities for maximizing labor savings and automation.

Moves such as the opening of the Textiles Development Center on Seta Plant premises in October 1981 and installation of an artificial weather simulation laboratory, “Technorama,” in November 1983 were part of synchronized efforts to bolster textile development facilities, strengthen structures for fiber application processing, pursue collaboration with apparel manufacturers, and strengthen marketing.

Since the 1960s, Toray’s synthetic fiber material development had been geared toward generating high-value. A prime example of a product for which this was achieved was “Sillook” fabric, made from modified cross-section filament. The development eventuated through a collaboration with the place where the processing took place. Sillook fabric has a silk-like luster and soft texture created by soaking fabric woven with Sillook modified cross-section polyester filament in an alkaline solution to dissolve the surface of the fiber, reducing the weight. Employing technologies used in Japan in the production of silk fabric, this continuous denier reduction treatment was successfully carried out by Komatsu

Seiren Co., Ltd., a dyeing company in Ishikawa Prefecture that had spent many years on the development. Afterward, Toray used polyester to develop a blended yarn with varying degrees of shrinkage, naming it “Sillook II,” and then developed



Sillook 20th anniversary (October 1983)

“Sillook III,” a yarn with a latent random crimp in imitation of the random crimp of silk, and marketed it as a textile with high added value. The Sillook series achieved growth due to its quality and systematic marketing. Around the time of the 20th anniversary of its launch, it accounted for around 15 percent of the total volume of polyester filament yarn.

In June 1971, “Ecsaine” (changed to “Ultrasuede” in 2013) was selected as the trade name in the domestic market for Toray-223, an artificial leather with a deerskin touch. That same month, the Gifu Plant commenced operations. It was right at that time that the Japan-U.S. textile war was reaching its peak, but Toray-223, which was similar to deerskin and other suedes, also lightweight, and had excellent coloring properties, earned a strong reception as interest among protectors of animals’ rights swelled, particularly in the U.S. The same year, Toray entered an agreement with major U.S. converter Springs Mills, Inc., opening up a sales channel into the U.S. domestic market. Sales began using the brand, Ultrasuede.

In Europe, Toray licensed its artificial leather technology to Italian synthetic fiber company Azienda Nazionale Idrogenazione Combustibili (ANIC) S.p.A (now EniChem S.p.A). The two companies signed a licensing agreement in October 1972, and established Iganto S.p.A (now Alcantara S.p.A) in April 1974. Iganto was to manufacture and sell artificial leather under the brand, “Alcantara,” and operations got



Iganto (now Alcantara) (Italy, 1977)

underway in June 1975. In March 1977, the company also received technology for staple fibers production, so that it then had an integrated production system from staple fibers through to the finished product.

Moving into the latter half of the 1970s, competition among materials in the industrial materials and interior domains intensified with the sophistication and diversification of customer quality requirements. Toray adopted a strategy of marketing the three materials—nylon 6, nylon 66, and polyester—together. By combining the three materials and manufacturing methods, Toray aimed to unearth new applications in the general industrial materials and interior domains in addition to the main existing applications of tire cords and fishing nets. A broad range of applications were sought, including “BCF” nylon for carpet, nylon 66 for computer ribbon, “Axstar” non-woven fabric made from polyester filament, and artificial turf “Spuckturf.” In April 1983, an Industrial Material Development Center was established on the premises of the Seta Plant, and development of fiber processed products for use as industrial material expanded.



Spuckturf artificial turf



Teton tire cords

Development and Reorganization of Overseas Fibers and Textiles Business

One starting point for Toray’s overseas fibers and textiles business was the Tangerang Project in Indonesia. In the early 1970s, the company set up centers for integrated production in the Tangerang district on the outskirts of Jakarta, establishing P.T. Indonesia Toray Synthetics (ITS), which undertook polyester polymerization through to spinning, and P.T. Indonesia Synthetic Textile Mills (ISTEM), manufacturer of polyester/ rayon blended yarn and fabric. Another starting point was the Textile Alliance Ltd. (TAL) Project undertaken with overseas Chinese entrepreneurs based in Hong Kong. The aim of the project, while positioning advanced western nations as the desired end markets for sewn products, was to establish production and processing bases for each stage in locations worldwide deemed most suitable for facilitating the delivery of products to those end markets, and to build plants there. As part of the project, Toray established Penfibre Sdn. Berhad (PFR) as a joint venture with TAL in the Malaysian province of Penang, which had set up a large (for its time) free trade zone and had adopted a policy of luring businesses to promote trade. By teaming up with companies in the TAL Group, Toray built a center of polyester/cotton blended textile production with integrated staple fibers, spinning, weaving, and dyeing operations.

Joint operations with TAL were undertaken in Thailand and Indonesia too. Toray had already established companies in Thailand in 1963—polyester/rayon blended textile manufacturer TTTM, and nylon filament yarn company Toray Nylon Thai Co., Ltd. (TNT, now Thai Toray Synthetics Co., Ltd. (TTS))—but additionally acquired an equity stake



LTX (Thailand)

in TAL Group company Luckytex (Thailand) Company Limited (now Luckytex (Thailand) Public Company Limited; LTX) in 1972. In Indonesia, Toray established P.T. Easterntex (ETX) in Surabaya, East Java, in 1973. Both LTX and ETX engaged in spinning and weaving of

polyester/cotton blended fibers.

In 1981, Toray accepted an offer from major TAL shareholder Jardine, Matheson & Co., Ltd. by purchasing the latter's TAL holdings of 3.3 million shares. The acquisition increased Toray's stake to 61.5 percent (the total investment coming to 13.8 billion yen), making TAL and all of its group companies consolidated subsidiaries. Once TAL's reorganization was completed in 1983, having executed a strategy to split the company into three, Toray was in possession of a broad network of fiber application processing businesses, engaged in spinning, weaving, and dyeing, spanning three major ASEAN nations—Thailand, Malaysia, and Indonesia. At this point, all companies were suffering big losses, but export competitiveness increased considerably as the yen, won and Taiwanese dollar appreciated in the wake of the 1985 Plaza Accord, leading to success in western markets and dramatically improved earnings across the board.

Plastics Business Development

After the first oil crisis in 1973, the “Lumirror” polyester film business enjoyed rapid growth as, in addition to existing uses, new opportunities

were identified in the market for magnetic tape for the various home video formats. Lumirror went on to secure an overwhelmingly dominant position, accounting for around 90 percent of the global market for video tape base film. And demand in areas other than magnetic tape increased at roughly the same pace as the magnetic tape demand.

The “Torayfan” polypropylene film business, which had long been in a slump, took until fiscal 1983 to pull off a remarkable comeback. Torayfan capacitor film was well received by customers at home and abroad due to its high functionality. In 1984, Toray was approached about a takeover of American polypropylene manufacturer Trea Industries, Inc. of Rhode Island. An agreement was reached in February 1985 and the acquisition was completed in May. Supplied with technology from Toray, Trea (now Toray Plastics (America), Inc.; TPA) started work on a new plant. “Toraypef” cross-linked high-expansion polyolefin foam had been experiencing an extended slump, but the future was looking brighter with potential seen in areas where the product's characteristics could be harnessed, such as instrument panels and molded door panels in automobiles.

In the resin business, though the oil crisis momentarily slammed the brakes on the growth of such products as nylon resin, higher oil prices turned out to be beneficial over the mid-term. In the automotive industry, in particular, plastic came to be readily used as a way to reduce weight, and therefore improve fuel economy. “Toyolac” ABS resin business was arrived late on the scene, even for the Japanese domestic market, but Toray managed to establish a unique position by carving out a market for automotive exterior applications. As for polybutylene terephthalate (PBT) resin, Toray started building up a market in 1972. In fiscal 1980, the

fifth year since production began at the Nagoya Plant in March 1975, the business booked a profit.

With regard to electronic materials, Toray was developing heat-resistant insulating varnish and transparent conductive film during the early 1970s when it also started importing and selling ‘Kapton’ polyimide film developed by DuPont. After establishing the Electronic Materials Department in 1979, Toray started sales of electron beam resists the following year, 1980, polyimide coatings in 1985, and “Raytela” plastic optical fiber in 1986. It was during this period, when white goods (e.g. washing machines and refrigerators) were being replaced as the core home appliance business by information and communication electronics such as televisions, personal computers and mobile phones, and the market itself was rapidly growing, that Toray laid the foundations for business in the new domain of electronic materials.

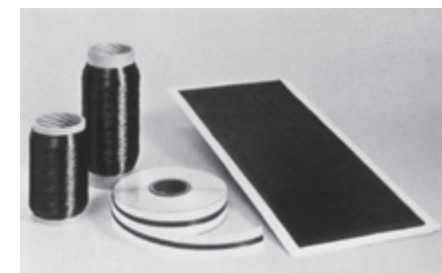
Progress and Achievements of New Business Development

In April 1971, the New Projects Development Department, a new organization that did not fall under any business division, was set up to play the central role in advancing and coordinating the planning of new businesses. While new businesses, in Toray’s case, would preferably consist of new products stemming from seeds of technology that the company already possessed, the new department came up with new businesses that included market-driven, needs-based businesses. Carbon fiber composite materials are a classic example of a seeds-based new business that opened up new markets with new materials that never existed before. Related R&D activities were pursued in-house since the early 1960s and never

ceased. Not even during times of recession did anyone entertain the idea of ending the research.

A facility for trial production of high-performance polyacrylonitrile (PAN)-based carbon fiber was established at the Shiga Plant, and sales of the material, under the trade name “Torayca,” began in August 1971. In November the following year, work began on construction of a facility with a six-ton monthly production capacity at the Ehime Plant. Meanwhile, Toray established a sales channel into the U.S. market, primarily for commercial aircraft applications, through Union Carbide Corporation, and developed the business in Japan, too, with applications to sport (golf shafts, fishing rods, and tennis rackets) and industrial uses. In July 1981, Toray settled on a plan to make inroads into Europe through a joint venture with Société Nationale Elf Aquitaine (now Total S.A.), as recommended by the French government. The two companies signed a technology assistance agreement in September 1982 before establishing Société des Fibres de Carbone S.A. (SOFICAR; Elf: 65 percent, Toray: 35 percent) in December. SOFICAR later became a three-way joint venture with the participation of Pechiney Ugine Kuhlmann S.A., whose plans for a joint venture with Hercules Inc. had fallen through. The company’s plant in Abidos, near the border with Spain, started operations in August 1985.

In the pharmaceuticals domain, Toray began research on natural prostaglandins in 1971. Clinical development of prostaglandins as a labor



Torayca carbon fiber

induction agent were conducted jointly with Kaken Chemicals K.K. (now Kaken Pharmaceutical Co., Ltd.) and permits were granted for the manufacture of PGF_{2α} in August 1977, and a stable PGE₂ in September 1983. Both were sold by Kaken Chemicals. Also in 1983, phase I clinical trials of a PGI₂ derivative as a new drug (trade name “Dorner”) began.



Interferon research in progress

Interferon research, too, moved into development of a system for large-scale production and refining of human diploid cells in the late 1970s. In 1978, the interferon research team at Japan’s Ministry of Health and Welfare (now the Ministry of Health, Labour and Welfare) commenced clinical trials.

In December 1982, Toray applied for a permit to manufacture natural high-purity interferon β under the trade name “Feron,” having succeeded in its large-scale cultivation. It was to be used in the case of indications of malignant melanoma, glioblastoma (a type of brain tumor), and hepatitis B. Approval of manufacturing was granted in April 1985 for all but hepatitis B. It was Japan’s first case of an interferon being approved as a pharmaceutical. As for hepatitis B, the Ministry of Health and Welfare directed Toray to carry out additional clinical trials. After this was done, approval for the additional efficacy was granted in September 1986.

In the medical products field, full-scale production of “Filtryzer” artificial kidneys at the Okazaki Plant got underway in 1979. In addition, “Anthron” antithrombogenic catheters were added to the product lineup

in 1977. Toray Medical Co., Ltd. was established in 1980 to sell Filtryzer and peripheral equipment.

In the graphic systems business, the “Torelief” photosensitive nylon resin relief printing plate was launched in 1973, as was the “Toray Waterless Plate,” a lithographic printing plate that does not require dampening water, in October 1979. Development and production operations for reverse osmosis (RO) membrane business were transferred from the Engineering Research Laboratories to the development department in 1975. And in April 1980, sales of membrane modules under the trade name “Romembra” began. Full-scale production got underway at the Ehime Plant in 1985.



Kickoff ceremony for the RO membrane facility at Ehime Plant (April 1985)

In the optical business, Toray supplied plastic spectacle lenses for eyesight correction and eyestrain prevention filters for visual display terminals (VDT). “Breath-O” soft contact lenses were also developed using a polymer with high moisture content, and went on sale in Japan for use after cataract surgery in August 1981. In 1986, Toray launched the home water purifier, “Torayvino,” which applies artificial kidney hollow-fiber membrane technology, and worked to develop sales channels and generate demand.

Promotion of Group Management and Global Management: 1987–1996

Innovation in Attitudes and Practices, and Management Reform (1987–1991)

The rise in value of the yen after the 1985 Plaza Accord was damaging to Japanese manufacturing, but results recovered thanks to the efforts of corporations and falling cost of imported raw materials and fuel. However, the strong yen led to an increase in imported items, and at the same time encouraged production overseas. In the Japanese economy, structural reform was urged, but the period of economic expansion that began in December 1986 extended to 51 months, up to February 1991, with Japan experiencing a consumer boom marked by rising share and land values. It was the *bubble economy*.

In April 1987, Yoshikazu Ito stepped aside to become chairman and Managing Director Katsunosuke Maeda took his place as president. Two consecutive terms of sales and profit contraction, fiscal years 1985 and 1986, saw Toray's share value fall behind competitors Asahi Chemical Industry Co., Ltd. (now Asahi Kasei Corporation) and Teijin Limited.

Maeda, soon after becoming president, stressed that while the domestic fibers and textiles industry was maturing, globally it was an industry of limitless growth. Media at the time loudly proclaimed the industry was in decline and “the sun is setting on Toray as once an excellent company.” To employees who were beginning to lose confidence, Maeda kept reminding them that a profit recovery could still be achieved in the short term if they took active steps to improve themselves; that it was in the fibers and textiles business that Toray had accumulated its technological and sales know-how; and that reconstructing the business was the quickest way to reviving it. And he called for shifting to a corporate approach of paying close attention to the actual place where operations occur, actual items handled, and actual realities.

Sales and profit both fell by large margins in financial results for fiscal 1986, but reductions in fixed costs, in particular, had an immediate effect with earnings picking up from fiscal 1987. The economy also improved rapidly—in fact, it became somewhat overheated—and it was during that time that Toray's project to restructure competitiveness in the fibers and textiles business began to have success.

In May 1988, all managers were issued a booklet they could carry around with them entitled, *Five Key Points in Innovation in Attitudes and Practices*. It was a collection of Maeda's own words and provided a check list for shaping each of the five key aspects into specific action. The booklet called for facing up to realities and making improvements



Katsunosuke Maeda



Booklet *Five Key Points in Innovation in Attitudes and Practices*

in areas that needed them; emphasis on practice of particular action as opposed to abstract arguments; adoption of principles of competition; management of clear goals; doing away with uniformity; workplace discipline; and innovating attitudes and practices. It ends by declaring that all managers and all staff, too, must “come down on the ground.”

In 1988, the Affiliated Companies Division was established and, as a general rule, Toray’s domestic subsidiaries and affiliates were grouped under it. Emphasis was placed on consolidated results, encompassing the entire Toray Group, including overseas affiliates, and achieving such a style of business administration was positioned as an important issue for management, with organizations and structures for implementation being defined. To carry through a policy of drawing a sharp distinction between research and development, the Development Department of the Research & Development Division was abolished in August 1987 and new development promotion groups were established within the Technology Center, which was created in 1985. Furthermore, Maeda, rather than lay down numerical targets, stressed the importance of setting issues and challenges, and devising and executing solutions. He therefore did away with the earlier format of management plans and instead introduced a system of “mid-term management program.” In April 1991, Toray also compiled the AP-G2000 long-term corporate vision.

Execution of Strategy Looking to the 21st Century (1992–1996)

Having peaked in February 1991, the Japanese economy entered a recessionary phase. The length of the period of deceleration, extending to 32 months, and the depths to which it plunged lent to its being recognized as the “collapse of the bubble.” It is considered a complex recession as it was compounded by a number of different factors and outcomes. Toray felt the effects as consolidated and non-consolidated sales and profit declined in fiscal 1992 for the second year running. The result was the same in fiscal 1993. In November 1993, the economy picked up again, entering an expansion phase. A period of growth known as the Sazanami boom followed and would last 43 months until May 1997. Toray recorded sales and profit increases in fiscal 1995, as it did for a second consecutive term, fiscal 1996, when consolidated sales exceeded one trillion yen for the first time.

Around this time, Toray laid plans to generate new business and venture into new locations from a mid- to long-term perspective in anticipation of the coming 21st century. The reason Toray set up an Electronics and Information-related Products Division and a Pharmaceuticals and Medical Products Division in 1988 was because it believed that establishing business domains according to those groupings and assigning senior executives to take responsibility for each individual business would allow more efficient operations. The company also undertook aggressive investment overseas from a mid- to long-term vantage point, particularly in relation to strategic products “Lumirror” and “Torayca.”

In regard to new locations, Toray launched the Nantong Project in 1994, securing land spanning an area of one million square meters in

the city of Nantong in China's Jiangsu Province. China's population was already approaching 1.2 billion at the time, and the economy was growing, creating expectations of major growth in internal demand. There was also a plentiful supply of labor. As such, the manufacturing sector could expect to grow, including as an export industry.

Two joint ventures were set up with Sakai Ovex Co., Ltd.—polyester filament textile dyeing company Toray Sakai Printing & Dyeing (Nantong) Co., Ltd. (TSD), in August 1994, and Toray Sakai Weaving (Nantong) Co., Ltd. (TSW), a weaving company to supply textiles to TSD, in September 1995. In May that same year, Toray also established Toray Fibers (Nantong) Co., Ltd. (TFNL), with facilities for polyester polymerization and spinning, thus putting in place an integrated system from polymerization through to spinning, weaving and dyeing. The

Nantong Project was the beachhead via which Toray would expand business in China.

In April 1991, Toray formulated its AP-G2000 long-term corporate vision. The vision identified three elements of a direction for the Toray Group, represented by key terms indicating the long-term outlook—growth, group management, and globalization. It also issued seven guiding principles, namely, strengthen corporate structure and attitudes and practices; pursue group management; globalize; secure and



TSD opening ceremony (1996)



TFNL ground-breaking ceremony (1997)

develop human resources; strengthen basic research and fundamental technologies; address environmental matters; and shape a new corporate culture.

In April 1992, the three-year Identity 2000 (ID-2000) campaign was launched. ID-2000 was a group-wide campaign organized to let employees establish an identity for themselves and to shape a new corporate culture. One core program of the campaign was the Junior Board. Suggestions put forward by the Junior Board initiated extended discussion about revising Toray's management philosophy. A new management philosophy framework was announced at the ID-2000 closing conference in April 1995.

Management Philosophy Framework

Corporate Philosophy	Contributing to society through the creation of new value with innovative ideas, technologies and products
Corporate Missions	
For our customers	To provide new value to our customers through high-quality products and superior services
For our employees	To provide our employees with opportunities for self-development in a challenging environment
For our shareholders	To provide our shareholders with dependable and trustworthy management
For the local community	To act as a responsible corporate citizen to build a long-lasting beneficial partnership with the local communities in which we do business
Guiding Principles	Safety and Environment Customer Satisfaction International Competitiveness Global Teamwork Identity and Self-Improvement Meaning in Work Fairness and Sincerity

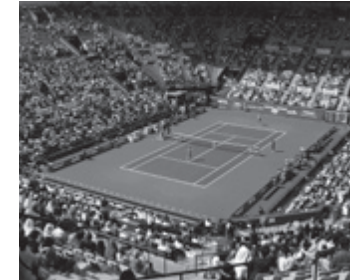
In December 1991, training for the purpose of strengthening management capability began (as the Toray School of Management). And because the existing training center was too small, a plan was devised to construct a new training center where level-based training programs and the Toray School of Management, for example, could take place, and which would have a large conference hall for holding welcome ceremonies for new employees and various group reporting sessions. The Toray Human Resources Development Center was completed in March 1996, replete with a large hall, training rooms, and a lodging facility, as well as a Corporate Culture Zone with exhibits explaining Toray's history and products.



Toray Human Resources Development Center

At around this time, Toray readily engaged in activities providing support for science and technology, arts and culture, and sports as a way of giving back to society, boosting its reputation. In Europe, on the occasion of its acquisition of a textile subsidiary of British company Courtaulds, Toray contributed 10 million pounds toward the establishment of an art museum where numerous masterpieces gifted to the University of London by the fourth generation of the Courtaulds founding family would be put on public display. In Asia, Toray Science Foundations were established in each of three countries—Malaysia, Indonesia, and Thailand—in 1993 and 1994. The foundations' activities involved provision of grants supporting the promotion of science and technology in those countries, and recognition of notable achievements in science and

technology and science education. And in 1995, the company started supporting performances by Orchestra Asia, a novel orchestra featuring folk instruments from China, Korea, and Japan. Members of Orchestra Asia are selected from the China National Traditional Orchestra, the National Orchestra of Korea, and Pro Musica Nipponia. They perform in locations across China, Korea, and Japan, opening up a unique new sound in the world of music.



Toray Pan Pacific Open Tennis Tournament

In 1987, Toray decided to continue its role as title sponsor of women's professional tennis tournament the Toray Pan Pacific Open Tennis Tournament, having commenced its support in 1984 as part of its "new founding campaign." It is a tournament on the Women's Tennis Association (WTA) Tour and has been held ever since, the biggest international women's pro tennis tournament in Japan. The 35th tournament was held in 2018. It continues to extend the world record for the longest time a tennis tournament has been supported by a single sponsor.

Strategic Restructuring of Business—Survival and Globalization of Core Business

As economic conditions deteriorated and internal demand slumped, Japanese synthetic textile manufacturers sustained sales volume by shifting their focus onto exports. So when the competitiveness of their exports was undermined by the appreciation of the yen following the

Plaza Accord of September 1985, production volume fell dramatically. On the other hand, competitors in Korea and Taiwan expanded their facilities considerably, gaining tremendous cost competitiveness. In 1985, more polyester filament yarn was produced in Taiwan than in Japan, and by 1987, Japan had been outstripped by Korea, too. Taiwan surpassed Japan in terms of total production of all types of synthetic fiber combined in 1987. China and Korea did the same in 1991 and 1992 respectively. In regard to its fibers and textiles business, Toray was in a dilemma—sustain operations and watch inventories stack up or cut production and feel the immense burden of fixed costs. Profit plummeted from fiscal 1985.

It was against this backdrop that the Fibers & Textiles Division and the Manufacturing Division drew up and implemented an Action Program for Survival (APS), a plan to reform business structure. The aims of the APS included establishing conditions for survival in light of changes in the business environment; defining business, sales and technology strategies for achieving those conditions; and setting a standard level of profit for the fibers and textiles business to realize over the mid-term. Concurrent with implementation of the APS, there was a shift in marketing strategy. Sales promotion activities targeting domestic demand would focus on domains such as women's wear, while in the export market emphasis would be placed on knitted and woven fabrics on the assumption they would return to Japan as imported garments or other products. Ahead of business structure reform in Japan, Toray Group's fiber and textile manufacturers in Thailand, Indonesia, and Malaysia advanced their own structural reform projects, improving quality and profitability as part of a shift of orientation away from domestic demand and toward exports. In 1986, conditions for export improved,

leading to strong performances by all of the companies in 1987. In addition to existing spun fabric businesses, such as polyester/cotton and polyester/rayon blended textiles, production of polyester filament fabric got underway at Luckytex (Thailand) Company Limited (LTX) in 1989. That same year, Toray agreed to a request from Courtaulds for it to acquire Samuel Courtauld & Co., Ltd., a textile subsidiary of the British company. As well as renaming the company "Toray Textiles Europe Ltd." (TTEL), a new plant was established to carry out integrated operations from fiber processing through to weaving and dyeing.

In order to bolster production systems for filament yarn operations in response to these moves to expand business in fiber application processing domains, Toray, Toray Nylon Thai Co, Ltd. (TNT, now Thai Toray Synthetics Co., Ltd. (TTS)), and LTX jointly invested in the establishment of a new company, Toray Fibers (Thailand) Ltd. (TFL, now TTS) in April 1991. This put in place an integrated polyester filament production system in Thailand for carrying out spinning through to weaving and dyeing.

Meanwhile, Lumirror managed to retain its status as global leader in the polyester film industry through successive facility expansions and enhancements and secure its position as a mainstay business within Toray. In Japan, Lumirror operations were concentrated at the Mishima Plant, for magnetic material applications, and the Gifu Plant, for industrial material applications. Toray's first overseas Lumirror production facility went online in 1991, at Toray Plastics (America), Inc. (TPA) in the United States. In 1996, Toray acquired the films subsidiary of French firm Rhône-Poulenc S.A. and established Toray Plastics Europe S.A. (TPEU; facilities later transferred to Toray Films Europe S.A.S. (TFE)). A decision



Signing of the acquisition agreement with Rhône-Poulenc (September 1996)

was also made to engage in local production of Lumirror at Penfibre Sdn. Berhad (PFR) in Malaysia (production began in mid-1998). As a result, Toray now had structures in place for producing Lumirror in four areas worldwide, including Japan. As for “Torayfan,” TPA’s production facility

went online in 1988 and the Japanese domestic business also grew. However, profit plunged after peaking in 1991. An APS was formulated for each of the Torayfan and Lumirror businesses in 1993.

In the “Toyolac” business, a newly developed process achieving major cost reductions was introduced to the Chiba Plant, with the new setup operational from 1987. In 1990, Toray Plastics (Malaysia) Sdn. Berhad (TPM) was established. Production was divided between TPM, which took on general-purpose products, and Japan, manufacturing products with high added value. With regard to polyphenylene sulfide (PPS) resin business, Toray took over operations undertaken by Phillips Petroleum Toray Inc. in June 1991.

Aggressive Development of Strategic Business and Cultivation of New Business

Carbon fiber composite materials, the new business Toray was pursuing, also reached a major juncture. The Boeing Company of the U.S. was developing a next-generation civil airliner, the Boeing 777, and was exploring the use of carbon fiber composite materials for primary structural



Rollout of the Boeing 777
©The Boeing Company



TCA (now CMA) (United States, 1992)

components, publicly disclosing its target specifications. The Technology Center responded, designating development of prepreg technology for the 777 as a specific urgent task in December 1988. Researchers and engineers from many different fields were enlisted and, in a short period of time, developed a prepreg with high-toughness based on a particle-toughened interlayer. In April 1990, the material was approved under Boeing’s standards for primary structural materials and it was the only carbon fiber prepreg selected for primary structural components of the 777. To supply Boeing, Toray decided to establish a new line at the Ehime Plant, as well as undertake production locally in the U.S. Obtaining a site adjacent to Boeing’s plant on the outskirts of Seattle, Washington, Toray established Toray Composites (America), Inc. (TCA) (now Toray Composite Materials America, Inc. (CMA)) in May 1992.

In Europe, the continent’s leading manufacturer of civil aircraft, France’s Airbus Industrie GIE, had considered using carbon fiber reinforced plastic (CFRP) components during development of the A310, and in 1987 adopted a prepreg employing a product manufactured by Société des Fibres de Carbone S.A. (SOFICAR, now Toray Carbon Fibers

Europe S.A. (CFE)) for the tail assembly of the A320. SOFICAR started out afresh as a new company in December 1988 with Toray gaining the controlling interest (Toray: 70 percent, Atochem S.A. (now Arkema S.A.): 30 percent).



Dorner

Consolidated profit for the composite materials business deteriorated after 1991 and efforts were made to optimize operations for the different products at the Ehime Plant and SOFICAR. Global operations were pursued and profits stabilized.

In the medical domain, Toray and Kaken Pharmaceutical K.K. jointly filed an application relating to PGI₂ oral derivative “Dorner” with the Ministry of Health and Welfare. Approval for manufacture was granted in January 1992. In order to establish a distribution framework for Dorner, Toray entered an agreement granting Yamanouchi Pharmaceutical Co., Ltd. (now Astellas Pharma Inc.) non-exclusive distribution rights in 1988, while Toray Medical Co., Ltd. also sold the product, a decision being made to supply ingredients for the drug to Kaken Pharmaceutical.

In April 1988, the electronic materials and graphic systems (printing materials) businesses were integrated and an Electronics and Information-related Products Division was established as an independent organization. Also incorporated into the division, as new development projects, were businesses such as IC molding encapsulant, toner for *kanji* (Chinese character) printers, and optical fiber. Toray, which had recognized the future potential of liquid-crystal displays (LCDs) early on, developed a unique color paste in 1985, based on which the

company advanced development of a color filter for thin-film transistor (TFT) LCDs. Production gradually expanded, from the establishment of a pilot production facility, LM-1, in October 1993, and LM-2 in 1995 at the Seta Plant to creation of LM-3 in 1996 and LM-4 in 1999 at the Shiga Plant. However, panel prices fell sharply and profits deteriorated. A survival project was initiated in 2002. At the same time as production on a fifth line, LM-5, got underway in 2005, Toray switched to a new strategy, breaking free from competition to create larger-sized panels, instead specializing in small- to medium-sized panels for mobile phones and car navigation systems.

In April 1990, Toray launched the Amenity & Civil Engineering (ACE) Project with the purpose of strategically developing housing and building material, and water and air purification businesses. Then in February 1991, the ACE Division was established, grouping together items including “Romembra” reverse osmosis (RO) membrane, “Torayvino” home water purifiers, and “Spuckturf” artificial turf. In June, the Consumer Products Division was established to strengthen the end-products field, taking on optical business (e.g. plastic lenses and contact lenses), the “Toraysee” microfiber cleaning cloth business, and apparel products business.



Romembra



Torayvino (mini)

Great Leaps toward a Highly Profitable Corporate Group: 1997–2006

Business Conditions Fluctuate and Earnings Plummet (1997–2001)

• The Economic Climate and New Leadership

In the 1990s, two events in Asia had an enormous impact worldwide. One was the financial crisis that began in 1997, starting in Thailand. The other event was the sudden rise of China as a major producing nation, the “factory of the world,” where labor costs were cheap. Around this period, in April 1997, Japan lifted the consumption tax, introduced in 1989, from three to five percent. One of the city banks collapsed and a leading securities firm was forced into voluntary closure. The following year witnessed the failure and nationalization of major banks. The Japanese economy, which had enjoyed a bubble period from the late 1980s to the early 1990s, began to lose momentum. Later, the 1990s came to be known as the *Lost Decade*.

It was in this economic climate that Toray overhauled the AP-G2000 long-term corporate vision it had announced in April 1991, releasing a new vision, New AP-G2000, in April 1997. In June, having spent a full

decade at the helm of the company as president, Katsunosuke Maeda stepped aside to become chairman, with Senior Managing Director Katsuhiko Hirai appointed to president and chief executive officer. Hirai sought employees’ understanding and cooperation on a course of action that included six basic measures retained from Maeda’s time as president—(1) innovate attitudes and strengthen corporate structure; (2) expand business; (3) globalize and pursue global operations; (4) pursue group management; (5) develop human resources; and (6) strengthen basic research and fundamental technologies—as well as five other key points —(1) think as individuals and exercise wisdom; (2) act with speed; (3) conform to global standards; (4) uphold corporate ethics; and (5) be positive and cheerful. Alongside these business management issues, Hirai recognized the importance of cultivating ethical values, setting up the Corporate Ethics Committee, which he chaired, in August 1997.



Katsuhiko Hirai

• Earnings Transition and Steps toward Management Reform

In Toray’s consolidated financial results for fiscal 1997, net sales were an all-time high 1.088 trillion yen, and operating income came to 71.9 billion yen. Due to the effects of the Asian financial crisis, however, sales and profit declined over the two consecutive fiscal terms, 1998 and 1999. In fiscal 1999, net sales fell below the trillion-yen mark and operating income dropped to 32.3 billion yen. In net terms, the result was a net loss of 65.7 billion yen due to the booking of 137.3 billion yen in extraordinary

losses, including a one-time cumulative recognition of retirement benefit liabilities and write-downs of real estate held for sale by subsidiaries. The biggest management problem Toray faced during this period was that 25 strategic, large-scale overseas capital investment projects, in which the company invested a total of around 200 billion yen, did not draw the projected 20 billion yen in annual incremental benefits.

Though Toray's earnings did pick up in fiscal 2000, stimulated by the dot-com bubble that lasted until November 2000, Japan was hit by a deflationary recession from December 2000. In fiscal 2001, the company's earnings fell well short of the forecasts it made at the beginning of the year, once again recording sales and profit decreases. There had been an influx of garments imports from China, which had grown into a major producing nation, putting pressure on Japan's domestic fibers and textiles business, and estimates for the polyester film business had been way off mark because of drastic changes in market structure occurring as disks (DVDs) began to replace video tapes. In addition, the slump in the aircraft market following the September 2001 terrorist attacks on the United States had a direct impact on the carbon fiber composite materials business. As a result, in consolidated results for fiscal 2001, net sales came to 1.016 trillion yen, a 5.5 percent year-on-year decrease. Operating income was 18.8 billion yen, a 63.2 percent decrease. In non-consolidated results, Toray recorded its first operating loss (-5.8 billion yen) outside its founding period.

Toray's Chairman Maeda, concerned about the direction that earnings were headed, convened a management roundtable of company officers in December 2001 to discuss strategies for rebuilding the Toray Group. Discussions continued in roundtable meetings of Board

members from January 2002, as well as in companywide meetings, such as meetings of the Executive Committee and the Board of Managing Directors. In these efforts geared toward structural reform, outside feedback on Toray, in the form of responses to questionnaires by customers and opinions of analysts and reporters, was carefully analyzed. That analysis contributed to a shared perception by the Board of Directors that (1) factor analysis of the earnings deterioration was insufficient; (2) budget and official figures were not based on norms; (3) accountability and investor relations were insufficient; (4) plans for the future were not presented; and (5) in overseas operations, the vitality of businesses in each nation had to be harnessed. In keeping with these reflections, mid-term management programs, formulated until then on an individual division or department basis, were overhauled so they would be compiled at the group-wide level with plans of heightened precision, achieved through fully attended discussions, publicly disclosed and robustly followed up to fulfill accountability and achieve high transparency. A new mid-term management program, Project New TORAY21 (NT21), was announced on April 1, 2002.

NT Reforms—Transformation into a New Toray (2002–2006)

• New Leadership for Escaping Management Crisis and NT21 Implementation

In April 2002, Toray's Chairman Maeda returned to the seat of CEO. In the meeting of the Board of Directors following the general meeting of shareholders at the end of June, President Hirai was appointed vice chairman, and Executive Vice President Sadayuki Sakakibara became



Sadayuki Sakakibara



Akikazu Shimomura

president and chief operating officer. This lineup remained until June 2004. Later, Sakakibara became president and CEO, with Maeda stepping down as a Board member to become honorary chairman. In June 2007, Executive Vice President Akikazu Shimomura was promoted to the vacant chairman post.

On April 1, 2002, after a press briefing announcing his preliminary appointment to president, Sakakibara held a meeting to announce a new mid-term management program and a long-term corporate vision, which he explained himself. The pamphlet distributed to all management personnel that same day, “Transforming into New Toray for the 21st Century—Project New TORAY₂₁ (NT₂₁),” contained a preamble entitled, “Transformation of the Management Idea that underlies NT₂₁.” The eight-point transformation of management ideas presented here is a response to changes in society’s structure, with Toray revealing both internally and externally a direction to transform the company and to change.

And in his message to employees distributed at time he was appointed president, Sakakibara analyzed the factors behind the rapid deterioration

of earnings and stated that it was his job “to return to observing actual realities directly, analyzing situations thoroughly, and acting with speed, and to lead the entire group in seeing to it that management reforms prescribed by NT₂₁ are properly implemented,” before getting stuck into the reforms.

The NT₂₁ mid-term management program was made up of three parts—(1) issues and reforms for the immediate future (pressing issues and reforms requiring implementation immediately or within two years); (2) issues and reforms for the near future (issues and reforms that need to be worked on immediately and implemented in three to five years); and (3) a long-term vision (looking five to ten years into the future). As the long-term vision, Toray simultaneously released the AP-New TORAY₂₁ long-term corporate vision. The aim of AP-New TORAY₂₁, while seeking growth expansion through global group management generally along the lines of the New AP-G2000, was to transform Toray from *monozukuri* (manufacturing-centric business) into a “New Value Creator” for the 21st century, a new business format that would involve creation of new value to deliver new solutions to customers. This would be achieved by incorporating expertise and know-how, for example from new services and new production and distribution systems. This was an attempt to build on and give concrete form to the corporate philosophy: “Contributing to society through the creation of new value with innovative ideas, technologies and products.” Those ideas would later be applied to management of Toray.

• NT_{2I} Achievements Reflected as NT-II Advances

Through NT_{2I}, Toray advanced five projects for reinforcing corporate structure with numerous achievements. (1) Marketing innovation involved efforts to implement the New Value Creator idea. (2) The project to strengthen total cost competitiveness reduced total costs by a total 26.3 billion yen over the two fiscal years 2002 and 2003. (3) In the project to rationalize global production, Okazaki Plant nylon tire cord filament facilities were converted to make products for airbags, and new facilities to produce filament yarn for nylon airbags were installed at Thai Toray Synthetics Co., Ltd. (TTS) in Thailand, while film facilities at Toray Plastics (America), Inc. (TPA) in the U.S. and Toray Plastics Europe S.A.S. (TPEU; facilities later transferred to Toray Films Europe S.A.S. (TFE)) in France were converted for packaging and industrial materials. (4) The project for business structure reform (a) made losing businesses and losing subsidiaries and affiliates profitable (reducing losses by around 30 billion yen between fiscal years 2001 and 2003); (b) strategically reorganized and integrated, or consolidated, subsidiaries and affiliates (measures were decided for 23 companies by the end of fiscal 2003); and (c)



TTS (Thailand)



Press conference to announce TBPR's establishment (February 2004)

undertook strategic M&A and business alliances, including the acquisition of DuPont's U.S. fluorofiber business, taking a stake in Suido Kiko Kaisha, Ltd., and the establishment of a PBT resin manufacturing joint venture, Toray BASF PBT Resin Sdn. Berhad (TBPR), in Malaysia with BASF SE of Germany. (5) The financial structure reform project sought to improve the efficiency of capital investments and curtail inventories, among other activities, and managed to achieve the target of reducing consolidated interest-bearing liabilities to around 500 billion yen by the end of fiscal 2004, one year early.

In fiscal 2003, signs of economic recovery began to appear in Japan and overseas, and Toray's net sales reached a new all-time high of 1.089 trillion yen, while operating income came to 56.8 billion yen, surpassing the NT_{2I} target for fiscal 2004 (50 billion yen or higher) a year early. With foundations in place for Toray to take on challenges and reforms that would propel it to even greater heights, the company embarked on a new mid-term management program, Project NT-II (NT-II), from fiscal 2004 as the second stage of reforms. Under NT-II, efforts to reinforce corporate structure were to continue, yet with an additional offensive (proactive) element. It was to be a major drive to become a highly profitable corporate group through reform of the business structure. The operating income target was 100 billion yen.

Achievements of the eight projects implemented under NT-II are summarized as follows.

(1) The activation of corporate culture project made efforts to strengthen communication both inside and outside the organization, horizontally and vertically, through the Multi-Communication (MC) campaign. (2) The project to strengthen total cost competitiveness made

continual progress on eliminating losses and wastefulness and raising cost and operational efficiency, realizing total cost reductions of 35.3 billion yen between fiscal years 2002 and 2004. (3) The financial structure strengthening project worked to reduce interest-bearing liabilities, which fell to 484.4 billion yen by the end of fiscal 2005. The NT-II debt-to-equity ratio target of 1.0 or lower was reached at the end of September 2005. (4) In the area of marketing reform, steps were taken to reform attitudes and ideas of marketing staff, promote the New Value Creator concept, build up IT, expand one-stop, full service functions (establishing the Automotive Material Strategic Planning Department), and halve inventories. (5) The project relating to strengthening of profit control according to individual products, with some success, improved the profit margin by eliminating products reporting a gross loss. (6) The project to expand advanced materials business increased sales of related products 40 percent from 305.4 billion yen in fiscal 2002 to 429.8 billion yen in fiscal 2005. Meanwhile, in the carbon fiber composite materials business, Toray was chosen as exclusive supplier of prepreg for primary structural material applications in the Boeing 787, the new aircraft Boeing was planning. (7) For expansion of No. 1 businesses, Toray increased No. 1 businesses such as carbon fiber, polyester film, and polyester/cotton blended textiles.



TSI (now TAK) (Korea)

Sales rose 25 percent from 265.9 billion yen to 330.5 billion yen between fiscal years 2002 and 2005. Taking the polyester film business, for example, Toray lifted earnings by consolidating production of polyester film for video tape destined for Japan, the U.S., and Europe at Toray

Saehan Inc. (TSI, now Toray Advanced Materials Korea Inc. (TAK)), established in Korea in 1999, in order to take advantage of the company's cost competitiveness. (8) For strategic expansion of businesses outside Japan, steps taken include the establishment in China of Toray Jifa (Qingdao) Textile Co., Ltd. (TJQ), a joint venture with the Jifa Group.

• NT-II Achievements Reflected as IT-2010 Formulated

While the global economy held firm, the effects of these reforms, as well as the inclusion of Chori Co., Ltd. and Suido Kiko Kaisha, Ltd. as consolidated subsidiaries, contributed to a near 20 percent increase in revenue in fiscal 2004, with net sales rising to 1.299 trillion yen. Operating income was 81.1 billion yen, surpassing the 81.0 billion yen recorded in fiscal 1990 at the height of Japan's economic bubble period. Both net sales and operating income were new all-time highs. Those records were broken again in fiscal 2005 as sales climbed to 1.427 trillion yen and operating income to 93 billion yen. Net income was 47.4 billion yen, hitting a new high after 16 years. By the end of the first half of fiscal 2006, Toray could see that it was going to achieve the 100 billion yen operating income target set under NT-II over the full year and therefore terminated the NT reform program at the end of September 2006. Over the full 12 months of fiscal 2006, net sales came to 1.546 trillion yen, operating income was 102.4 billion yen, and net income was 58.6 billion yen, meaning sales and profit had increased in five consecutive terms since the launch of the NT reforms in fiscal 2002, and earnings had exceeded the must-meet target under NT-II, consolidated operating income of 100 billion yen.

Earlier, in April 2006, a new long-term corporate vision, AP-Innovation TORAY 21, was announced. At the same time, partial



Campaign badge
(now the corporate badge)

revisions were made to the management philosophy and the Guiding Principles that were established in April 1995 as a reflection of the changing times. Toray also settled on a corporate slogan: “Innovation by Chemistry.” A campaign badge featuring both the corporate symbol and the new slogan was produced.

Six months later, in October, a new mid-term management program was introduced as Project Innovation TORAY 2010 (IT-2010). The economic environment was changing quickly due to factors including the rapid development of the industry encompassing information and telecommunications, the rise of China and other emerging nations, intensifying competition on the international stage, high oil prices, and heightened awareness of corporate social responsibility (CSR). To be able to adapt to these changes and achieve ongoing growth, the Toray Group, now with management infrastructure rebuilt through the NT reforms, had to work on technological innovation, while persisting with efforts to strengthen corporate structure. Toray sought to advance IT-2010 through such management reform, aiming for consolidated net sales of 1.8 trillion yen and consolidated operating income of 150 billion yen. Innovation was to be the key concept of IT-2010, with five kinds of innovation pursued—innovation of business structure, innovation of technologies, innovation of competitiveness, innovation of business awareness, and CSR innovation. At the same time, group-wide focal subjects were specified, along with key group-wide follow-up items. Group-wide focal subjects were (a) realignment of subsidiaries and affiliates in Japan; (b) study of

corporate organizations; (c) reformation of management accounting; and (d) improvement of personnel systems. Key group-wide follow-up items were (a) profitability of the advanced materials businesses; (b) profitability of strategic No. 1 businesses; (c) profitability of large-scale investments; and (d) financial strength. In addition, eight group-wide projects were formed, covering (1) business structure innovation; (2) overseas business strengthening; (3) advanced materials businesses expansion; (4) R&D capabilities innovation; (5) manufacturing technology innovation; (6) cost innovation; (7) marketing and sales innovation; and (8) corporate brand strengthening.

Aiming to Be Socially Responsible Toray

From the 1990s, the number of corporate scandals both in Japan and abroad jumped. That was the background to Toray’s moves to completely eradicate misconduct, such as setting up the Corporate Ethics Committee in 1997 and establishing the Corporate Ethics and Legal Compliance Code of Conduct (eight rules) in 2003, then compiling them into a *Corporate Ethics and Legal Compliance Handbook* for distribution. It was also around this time that corporations were strongly urged to bolster the transparency and accountability of company management through activities relating to compliance, investor relations and CSR, and to put in place governance frameworks.

CSR, the broadest concept, touches on the actual reason corporations exist and entails activity to ensure that a company can achieve sustained growth for the next 100 years while remaining an entity respected by society. Tracing Toray’s roots brings us to the Mitsui family and their

origins in Japan's former Omi Province (now Shiga Prefecture), which also happens to be where Toray was founded. Omi merchants followed a business code referred to as *sanpo yoshi* (lit. good three ways), signifying that business would begin to thrive only when it benefited the seller, the buyer, and all of society. It is a philosophy consistent with CSR today. With roots embedded in such a philosophy, Toray has attached importance to contributing to economic development and giving back to society—in other words, to the company's position as a public institution and its role in society—ever since its founding. The company principles, established in 1955, declared, "Toyo Rayon contributes to communities," a statement clearly expressing this managerial principle. It is a principle that lives on within Toray to this day, as incorporated into the Corporate Philosophy defined in 1986: "Contributing to society through the creation of new value with innovative ideas, technologies and products."

Toray first expressly addressed the CSR concept in 2003 with the formation of the group-wide CSR Committee. In January the following year, Toray established and released its Information Disclosure Principles, followed by a set of CSR Guidelines and associated action programs in December. Also that year, the company expanded the scope of reporting of its *Environmental Report*, which was first issued in 1999, and started publishing a *CSR Annual Report*.

Transformation into Toray, Leader in Advanced Materials

As a subtitle for NT-II, launched in April 2004, Toray used the expression, "Toray—The Leader in Advanced Materials." The company initiated a project to expand advanced materials business. Advanced materials

at the time referred to materials supplied to the domains of IT-related products, life sciences, and environment, safety, and amenity that were technologically highly innovative. Consolidated sales for the advanced materials business in fis-



Life-size model of a Boeing 787 fuselage on display at the Toray Advanced Materials Exhibition (September 2006)

cal 2003 had come to 344.1 billion yen, accounting for 31.6 percent of total net sales. Consolidated operating income was 32.2 billion, or 56.7 percent, meaning that in profit terms, the business already accounted for more than half. However, Toray wanted to expand the business further and decided to prioritize allocation of resources to advanced materials business, the target being 50 percent of consolidated capital expenditure.

In September 2006, Toray held the Toray Advanced Materials Symposium, inviting a number of notable public figures, including laureates of the Nobel Prize in Chemistry, as lecturers, and the Toray Advanced Materials Exhibition, introducing Toray's products and activities, at the Tokyo International Forum as part of 80th anniversary commemorations. The drawcard for the exhibition was a life-size (six-meter diameter) model of a fuselage for Boeing's next-generation airliner, the Boeing 787, which made use of carbon fiber "Torayca" in primary structural materials.

IT-2010, launched in October 2006, also made expansion of the advanced materials business a basic strategy and Toray set out to do

just that. Over the five years from 2006, Toray planned 600 billion yen in capital expenditure, half of which was to be invested in strategically expanding and developing businesses, primarily advanced materials. In R&D, which was to receive 240 billion yen in investment over five years, 80 percent of R&D resources were to be allocated to advanced materials. Toray thus aimed to become a global leader in advanced materials.

The following are some of the achievements of activities in the advanced materials business so far.

In the carbon fiber composite materials business, Toray Carbon Fibers America, Inc. (CFA, now Toray Composite Materials America, Inc. (CMA)) was established in Decatur, Alabama, in the U.S., in May 1997 to produce and sell carbon fiber, Torayca. With that, Toray had in place a three-region global operation spanning Japan, Europe, and the U.S. In May 2004, Toray entered a basic agreement relating to the long-term supply of unidirectional carbon fiber prepreg for primary structural components of the Boeing 787. Then in April 2006, the company signed a comprehensive long-term supply agreement lasting 16 years (with a five-year option) starting in 2006, including an additional order for



CFA (now CMA) opening ceremony (September 1999)

carbon fiber cloth prepreg for fuselages. The Boeing 787 employed carbon fiber composite materials for almost all its structural materials, which accounted for more than half of the weight of the entire aircraft. Therefore, around 35 tons of

Torayca prepreg was expected to be used per plane. To accommodate the business, a decision was made to expand carbon fiber facilities and establish a new precursor facility at CFA. By 2006, Toray had put in place a system of integrated production in the U.S. covering precursors through to carbonization.

In the electronics and information-related products business, Toray entered the plasma display panel (PDP) business. In 1998, Toray developed a photosensitive paste method for forming barrier ribs on PDP rear panels and established its own unique rear panel manufacturing process in 2000. Matsushita Electric Industrial Co., Ltd. (now Panasonic Corporation) took an interest in Toray's technology and the two companies agreed in September 2000 to team up in the PDP business. As plasma displays offered a fast response time, wide viewing angles, and excellent color reproduction, facilitating large-screen designs, plasma televisions were viewed as a potentially big business. In October, Toray and Matsushita established joint venture Matsushita Plasma Display Co., Ltd. (investment ratios: Matsushita 75 percent, Toray 25 percent; renamed Panasonic Plasma Display Co., Ltd. (PPD) in October 2008). PPD carried out integrated PDP production through to the finished product, with Toray providing the rear panel manufacturing technology. Despite successive production hikes and growth in plasma televisions' global market share, that global share was quickly eroded as plasma televisions were pushed out by LCD televisions due to technological innovation that saw the latter become larger, thinner, and more energy-efficient, with higher resolution, and improved cost performance. At the end of 2013, PPD discontinued plasma television production and ceased operations at the end of March 2014.



TMUS (United States)

In the water treatment membrane business, Toray developed a “two-stage RO (reverse osmosis)” seawater desalination system and then commercialized a low-fouling RO membrane, energizing orders of products for wastewater reclamation plants, too. In other activities, Toray commenced R&D related to ultrafiltration (UF) membranes in 1990, as well as microfiltration (MF) membranes and membrane bioreactor (MBR) processes in 1996, and the company’s successful product lineup allowed it to provide integrated membrane systems. Toray established the Water Treatment Division in 1999, and Toray Membrane America, Inc. (TMA) in the U.S. together with U.S. firm Ionics, Inc. and Mitsui & Co. (U.S.A.), Inc. in 2000, while also investing in Ropur AG of Switzerland. In September 2002, Toray entered a capital and business partnership with Suido Kiko Kaisha. The following year, Toray gained the controlling interest of Ropur, renamed it Toray Membrane Europe AG (TMEu) in 2004, and worked to expand the market in Europe, the Middle East, and North Africa. In 2005, the Global Sales Team was formed, and in 2006, Toray Membrane USA, Inc. (TMUS) was established as a wholly owned subsidiary, moving development of the U.S. market into top gear.

Development of New Products and New Supply Chains —Joint Development with UNIQLO

In the 1990s, the import penetration rate for apparel products in Japan was approaching 80 percent. In order to sustain and strengthen the domestic textile industry, urgency was required in accommodating structural change and undertaking structural reform of logistics, which had been an outstanding issue for many years.

The relationship between UNIQLO Co., Ltd. and Toray began in 1999 with sales of apparel; specifically, outerwear made with Toray materials. In early 2000, UNIQLO expressed a wish to “work together with Toray on filament yarn, staple fiber, spun yarn, and textiles, too.” After some deliberation, the Toray Group commenced supply of polyester padding for cold weather outerwear and polyester spun yarn for fleece jackets that same year, including from overseas bases. In May, a new Global Operations Promotion Department (now Global Operations Department) was established as a unit dedicated to providing a comprehensive, one-stop service to UNIQLO. Toray believed that strengthening the partnership between the two companies would bring about fundamental reform of logistics structure through the creation of a *total industry* unifying retail and manufacturing, thereby enabling UNIQLO and Toray to operate together as a virtual company.

The ultimate accomplishment of UNIQLO and Toray together was ‘Heattech,’ which began with the launch of moisture-absorbing, heat-generating, and heat-retaining innerwear for autumn and winter 2003. Strong requests for a soft texture, however, led to the creation of Heattech, combining four materials—acrylic, polyester, rayon,

and ‘Lycra’—in 2006 after repeated trial and error. Dyeing of the four types of material posed some difficulties, but once the dyeing technology was established, this four-way blend achieved the functionality the customer was looking for and was the originality behind the unassailable Heattech brand. Heattech both opened up the new market of synthetic men’s innerwear and carved out a market around a new concept of heat-generating, heat-retaining innerwear, for women, too. Heattech functionality did not stop at heat generation and retention. Each year, new and improved products were introduced, with new functions, such as moisture retention, stretching, shape retention, and static reduction, and production volume increased. To accommodate this, additional quality assurance and production facility expansions would have to be simultaneously implemented throughout the integrated production system from filament yarn to sewing, which would have been impossible without Toray’s leadership in controlling production teams.

In March 2006, UNIQLO and Toray sought to make their activities more robust by signing a mid- to long-term comprehensive procurement and supply agreement, followed by an implementation plan in June, before announcing the strategic partnership at a joint press briefing. Through this agreement, the two companies bridged the boundary between material manufacturer and specialty store retailer of private label apparel (SPA), and put in place a product development framework encompassing all steps from materials through to sales of the finished product.

Alongside these activities, the Toray Group took steps to establish a global supply framework, including expansion of production centers in ASEAN countries and Bangladesh in addition to China. As a result,

material and product supply to UNIQLO reached 250 billion yen, higher than planned for the five years 2006 to 2010, and measures advanced into a second phase. Total business over the five years of stage two spanning 2011 to 2015 came to 600 billion yen, and in November 2015, UNIQLO and Toray reached agreement on a third stage and expanded their business target to more than one trillion yen over the five years from 2016 to 2020.

Such groundbreaking efforts, supported by a global production structure, resulted in major hit products such as Heattech, ‘Ultra Light Down,’ and ‘Airism’ (all Fast Retailing Co., Ltd. trademarks).



Agreement was reached with UNIQLO on an implementation plan for the strategic partnership (June 2006)



Heattech



Reaching for New Heights: 2007–2016

Toray Group Action before and after the Lehman Shock (2007–2008)

Confusion in financial markets, triggered by the collapse of the housing bubble in the United States, led to the bankruptcy of major U.S. investment bank Lehman Brothers on September 15, 2008. The shockwaves rocked the world. The *Lehman shock* set off a vicious circle of credit contraction and economic decline, eventually resulting in a global crisis. Governments took swift action involving large-scale monetary easing and stimulus packages and the global economy started down a recovery path from around the spring of 2009. In Japan, the economic downturn was even more serious, due to a drop in exports combined with the effects of inventory adjustments and falling capital investment. The Japanese economy began to show signs of recovery in spring 2009, bolstered by subsequent government stimulus measures, such as eco-car subsidies and tax breaks and an eco-point system for home appliances, as well as the recovery of overseas markets.

Toray had been pushing to expand business and increase profits under Project IT-2010, launched in October 2006. As a result, net sales came to 1.650 trillion yen and operating income was 103.4 billion yen in consolidated financial results for fiscal 2007, record highs for the fifth and fourth years in a row respectively. Though the slowdown of the global economy was only moderate in the first half of fiscal 2008, the outlook was further deceleration. In August 2008, prior to the Lehman Brothers collapse, Toray acted on experience gained through Project NT21 to put in place a set of Group-wide Emergency Measures. The company proceeded with steps to pass on rise in raw materials prices to the sales price, urge a shift toward products with high added value, secure higher profits by lowering production costs, and reduce expenses. However, business conditions became worse after Lehman Brothers' failure the following month, prompting the transition to a second phase of Group-wide Emergency Measures in December. This included bold refocusing of priorities and changes in the areas of capital and R&D investment.

Economic conditions, though, subsequently deteriorated on a whole new level and cooling of final consumption demand triggered sharp inventory adjustments at each stage of the supply chain with major repercussions for the basic materials industry. Demand for Toray Group products took a massive hit, too, and because it was hard to predict a future recovery, overcoming the crisis became an urgent priority for the Toray Group. Toray decided to take bold action, leaving no aspect of operations free from scrutiny, except for firmly adhering to fundamental principles like ensuring safety, accident prevention and environmental preservation, and fulfilling its corporate social responsibility. Group-wide Emergency Measures moved to a third phase in February 2009. This involved

implementation of urgent measures, such as (1) reducing remuneration paid to executives; (2) reducing the year-end dividend; (3) reducing all kinds of costs; and (4) suspending group-wide events. In addition, numerical targets set under IT-2010 were frozen and a decision was made to pursue a new mid-term management program, Project IT-II, from April 1, 2009, with a focus on overcoming the economic crisis. It was such an extremely tough business environment that Toray's consolidated operating income for fiscal 2008 dropped as low as 36 billion yen and a net loss of 16.3 billion yen was recorded, partly due to a write-down of investment securities and losses from impairment of tangible fixed assets.

IT-II: Reforms with No Exception (2009–2010)

Project IT-II was a program that sought to mobilize the Toray Group for two years concentrating on overcoming the economic crisis through reforms extending to all aspects of operations, without exception. Five basic principles were established: (1) total cost reduction; (2) maximization of earnings by “ensuring sales through every possible effort” (i.e. selling everything based on optimal price strategies); (3) optimization of the scale and systems of businesses in response to structural changes in the business environment; (4) reduction of capital expenditure and working capital; and (5) promotion of business structure reform to prepare for future growth. To advance these principles, three group-wide projects were formed.

(1) The Total Cost Reduction Project (TC Project) aimed to reduce costs by 100 billion yen in total—60 billion yen in fixed costs and 40 billion yen in variable costs—over the two fiscal years 2009 and 2010.

(2) The Action Program for Survival Project (APS Project) sought to maximize earnings by “ensuring sales through every possible effort,” and to optimize scale and systems for marketing and sales, production, and development functions based on mid-term business environment and scale forecasts.

(3) The Action Program for Growth Project (APG Project) advanced business strategies based on a new approach of contributing to society through solutions to globally constraining factors on future economic growth, such as environmental issues, natural resources and energy, and an aging population with a diminishing birth rate, and the standpoint of harnessing growth in the massive market of Asia, especially China.

The results were as follows.

(1) The TC Project achieved the overall target having cut overall costs by 102 billion yen.

(2) The APS Project managed to increase sales volume by “ensuring sales through every possible effort” based on optimal pricing strategies, and to improve product spread, leading to a steady increase in gross profit after hitting bottom in the fourth quarter of fiscal 2008. The project attempted optimization of production scale and location in businesses such as color filters for LCDs.

(3) The following are some of the activities of the APG Project.

- In the IT-related business, invested in a lithium-ion battery separator film (BSF) business pursued by ExxonMobil Group company TonenGeneral Sekiyu K.K. (now JXTG Nippon Oil & Energy Corporation), and established Toray Tonen Specialty Separator Godo Kaisha in January 2010;

- In the carbon fiber composite materials business, entered a joint development agreement relating to CFRP automobile parts with German automaker Daimler AG in April 2010, and a long-term basic agreement on the supply of carbon fiber prepreg for Airbus aircraft with European Aeronautic Defence & Space Company NV (now Airbus SE) in May 2010.
- In China, established water treatment membrane manufacturing and sales company Toray BlueStar Membrane Co., Ltd. (TBMC) in Beijing in July 2009 as a joint venture with China National BlueStar (Group) Co., Ltd., the core corporate group of the China National Chemical Corporation; established Cangzhou Toray Fine Chemicals, Co., Ltd. (TFCC) as a joint venture with Toray Fine Chemicals Co., Ltd. and Sinopec Group company Sinopec Assets Management Corporation in Cangzhou, Hebei Province, in July 2009 to manufacture and sell dimethyl sulfoxide (DMSO); and installed an additional system for producing highly functional polypropylene (PP) spunbond for hygiene products at Toray Polytech (Nantong) Co., Ltd. (TPN), which opened for business in March 2008.



Signing of the basic agreement to establish BSF joint venture (November 2009)



TBMC ground-breaking ceremony (August 2009)

While not a group-wide project, Toray also undertook comprehensive efforts to reduce capital expenditure and working capital, which was the fourth basic principle. Free cash flow improved dramatically as a result.

The above activities led to better final consolidated earnings for fiscal 2009 than originally planned, except in terms of net profit, with Toray posting a large consolidated net loss for the second year running due, for example, to losses on impairment of fixed assets. In fiscal 2010, Toray achieved large year-on-year increases in sales and profit, recording 1.540 trillion yen in net sales, operating income of 100.1 billion yen, and net income of 57.9 billion yen.

Capital Raised through Public Stock Offering to Advance Growth Strategy

Toray's earnings deteriorated considerably in fiscal years 2008 and 2009 due to the effects of the global financial crisis stemming from the *Lehman shock*, and the company's debt-to-equity ratio, an indicator of financial strength, trended well above one. In order to aggressively develop business in fields and regions where growth was expected, Toray had to quickly turn finances around again, creating a financial structure that would allow it to invest in growth in a timely manner. This was the backdrop to Toray's procurement of additional funds through a public stock offering in June 2010, the objective being to finance expansion, primarily entry into the aforementioned BSF business. The amount of funds raised was 101.9 billion yen, half of which was added to paid-in capital, the other half to capital surplus. Toray's paid-in capital increased to 147.9 billion yen.

Transition to New Leadership

Having mapped a course for surviving managerial crisis and shifting focus onto advancing a growth strategy, Sadayuki Sakakibara was replaced as president by Executive Vice President Akihiro Nikkaku in June 2010. Sakakibara became chairman and CEO. Nikkaku became president and COO (and assumed the position of CEO, too, in June 2011).



Akihiro Nikkaku

Stating that “as the basic building blocks for all products, materials have the power to intrinsically change society,” President Nikkaku stressed the need to pursue research and development from a long-term perspective in order to create such innovative materials. He also encouraged employees to go about their jobs with confidence and pride, repeatedly conveying to them his management approach—determined to stay directly involved by adhering to basics, visualizing how the company should be, and doing whatever had to be done, and always acting for the benefit of the company, while trying to foster a corporate group that is a sound, trusted partner of the whole of society.

The Great East Japan Earthquake

On March 11, 2011, powerful tremors measuring up to level seven on the Japanese seismic intensity scale and the largest tsunami ever recorded in Japan caused immense damage primarily in the Tohoku and Kanto regions. This was the Great East Japan Earthquake. The Fukushima Daiichi Nuclear

Power Plant of the Tokyo Electric Power Company was also damaged, leading to the grave situation of the release of radioactive material.

The Toray Group was fortunate to have been spared human injury, but the scope and scale of the damage were vast, and secondary effects, such as power supply restrictions, also contributed to the disaster’s enormous impact on the Japanese economy. However, Japan’s economy returned to its pre-disaster level as early as July–September 2011 and improved moderately on the back of reconstruction-related demand into 2012.

Reform and Proactive Management (2011–2013)

• Formulation of AP-Growth TORAY 2020 and AP-G 2013

Looking ahead a decade to 2020, Toray formulated AP-Growth TORAY 2020 (Vision 2020), outlining a new long-term corporate vision for the Toray Group, and embarked on business structure reform, with fulfillment of corporate social responsibility and business expansion side by side as central elements. Vision 2020 was announced in February 2011 along with mid-term management program Project AP-G 2013, to be implemented over three years from April 2011.

Under AP-G 2013, Toray aimed to shift over to a new growth track, switching to a proactive management stance while continuing the reforms it had implemented so far. In keeping with this basic objective, the company established and pursued the following eight-point basic strategy.

- (1) Business expansion in growth business fields: Establish and pursue the Green Innovation Business Expansion (GR) Project to help find solutions to global environmental issues and resources and energy issues that will become increasingly significant.

- (2) Business expansion in growth countries and regions: Establish the Asia and Emerging Country Business Expansion (AE) Project, aiming to harness the enormous economic growth anticipated in Asia and emerging countries.
- (3) Capital investment strategy: Plan 350 billion yen in capital investment over three years and allocate two thirds of this investment to growth and expansion, 60 percent of which would go toward green innovation business, and allocate 50 percent of the total amount to business in Asia.
- (4) M&A and business alliance strategies: Make strategic decisions on priority themes, with activities funded by an allocation separate from capital investment.
- (5) R&D investment strategy: Invest 160 billion yen in R&D over three years. The plan was to invest 50 percent of that amount into R&D relating to green innovation.
- (6) Developing and securing human resources: Develop and secure personnel who will lead the creation and implementation of key strategies, and employ and foster employees who can excel globally.
- (7) Bolstering competitiveness: Continue the TC Project pursued under IT-II. The Total Cost Reduction (TC-II) Project was set up.
- (8) Ongoing promotion of business structure reform: Address loss-generating and developing businesses both in Japan and overseas and advance structural reforms.

• **AP-G 2013 Achievements and Transition of Earnings**

GR Project:

- Toray resolved in March 2012 to boost global carbon fiber production capacity by 6,000 tons annually and increase the Toray Group's overall

annual production capacity to 27,100 tons. The new lines were launched in turn between 2014 and 2015.

- In April 2013, Toray acquired all holdings of Dome Carbon Magic Ltd., representing the manufacturing arm of the Dome Group, a highly acclaimed racing car designer and manufacturer, and a 75-percent stake of a Dome production subsidiary in Thailand. They were renamed Toray Carbon Magic Co., Ltd. (TCM) and Carbon Magic (Thailand) Co., Ltd. (CMTH) respectively.
- Toray purchased American large tow carbon fiber manufacturer Zoltek Companies, Inc., making it a subsidiary in February 2014, thereby enhancing business for applications in fields such as wind energy and automobile structural parts.
- In the battery materials business, Toray made Toray Tonen Specialty Separator Godo Kaisha a wholly owned subsidiary in January 2012, establishing Toray Battery Separator Film Co., Ltd. (merged into Toray in April 2017).
- In the printing plate materials business, Toray established a new waterless plate production plant at Toray Textiles Central Europe s.r.o. (TTCE) in the Czech Republic, commencing production there in November 2013.



Zoltek's plant in Mexico



Opening of TTCE's new waterless plate plant (January 2014)

AE Project:

- Regarding China, Toray (1) commenced production of dialysis machines (May 2012), and made and announced a decision to build a new artificial kidney plant (January 2012; production began in April 2014); (2) established a third PP spunbond machine (August 2012); and (3) commenced resin compound production in Chengdu (August 2013).
- Regarding Korea, Toray (1) acquired a stake in Woongjin Chemical Co., Ltd., a manufacturer of fibers, textiles, and water treatment products, making it a consolidated subsidiary (February 2014; renamed Toray Chemical Korea Inc. (TCK) in April); (2) made and announced a decision to build a new polyphenylene sulfide (PPS) resin plant (October 2013; compound production began in October 2015, PPS resin production in April 2016); and (3) established an additional lithium-ion battery BSF facility (2012).
- Commenced PP spunbond (June 2013) and resin compound (November 2013) production in Indonesia.
- Made and announced a decision to bolster facilities for producing fiber for automobile airbags in Thailand (April 2013; production began in December 2014).



Dialysis machines and artificial kidney plant of Toray Medical (Qingdao) Co., Ltd. (TMQ) (China)



Completion ceremony for TAK's new PPS resin plant (Korea, July 2016)

- Other achievements include (1) establishing an office in India (September 2011); (2) expanding operations in Brazil (November 2012); and (3) opening an office of Toray International, Inc. in Turkey (July 2012).

The Great East Japan Earthquake had a huge impact at the start of fiscal 2011, but the domestic economy recovered quickly and the business environment was generally firm. Toray's consolidated operating income for the fiscal year reached a record 107.7 billion yen. Viewing the two halves separately, however, profit in the second half declined dramatically in contrast with the first half. This was due to the effects of deceleration of the global economy from the second half of the fiscal year, as well as the floods in Thailand during the latter half of 2011. In fiscal 2012, economic conditions were tough both in Japan and abroad. Factors such as the Thailand floods and slump in the market for flat panel televisions also had an impact on consolidated results of the Toray Group, with all profit indicators suffering year-on-year declines. In fiscal 2013, slowdown continued in China and other emerging economies, but U.S. and European economies entered a recovery phase, albeit a mild one. Domestically, there was a hint of brightness ahead and the economy improved, again mildly, as conditions in currency, stock and other markets picked up as a result of the *Abenomics* economic package pursued by the second administration of Shinzo Abe, formed in December 2012. Meanwhile, Toray posted year-on-year sales and profit increases in fiscal 2013, recording 1.838 trillion yen in net sales, 105.3 billion yen in operating income, and 59.6 billion yen in net income. The net sales figure was a new all-time high, while operating income and net income results were at second-highest levels.

Transition to a New Growth Phase (2014–2016)

• Formulation of AP-G 2016 (FY2014–2016)

In February 2014, Toray announced a new mid-term management program, Project AP-G 2016, to be implemented over three years from April 2014 as the second stage of its Vision 2020. AP-G 2016 specified the eight basic strategies below, based on the basic strategies of AP-G 2013, with measures advanced incorporating fresh perspectives.

- (1) Business expansion in growth business fields: Newly establish the Life Innovation Business Expansion (LI) Project to go alongside the existing Green Innovation Business Expansion (GR) Project. Under the LI Project, make the most of Toray's technology and business platform to enhance deployment of LI businesses, identified as businesses that help raise the quality of healthcare, ease the burden on medical institutions, or contribute to people's health and longevity.
- (2) Business expansion in growth countries and regions: With the addition of business expansion in the Americas, pursue activities through the Asia, Americas and Emerging Country Business Expansion (AE-II) Project.
- (3) Bolstering competitiveness: Undertake this through the Total Cost Reduction (TC-III) Project, incorporating the new perspectives of production process innovation and total cost reductions in sales and marketing operations.
- (4) Strengthening sales and marketing: Devise business strategies taking into account the entire supply chain and establish new supply chains.
- (5) R&D strategy and intellectual property strategy: Invest 180

billion yen in R&D over three years from fiscal 2014, allocating 50 percent to R&D related to green innovation and 20 percent to life innovation.

(6) Capital investment strategy: Plan 400 billion yen in capital investment over three years from fiscal 2014, allocating around 60 percent to growth fields and, by region, around 60 percent to Asia, emerging countries, and the Americas.

(7) M&A and business alliance strategy: Consider M&A and business alliances as options for achieving growth strategies, and invest funds separate from the capital investment allocation based on strategic decisions.

(8) Human resources strategy: Plan optimal assignment of employees to important areas, and secure and develop diverse human resources, including locally hired employees of operations worldwide.

To advance AP-G 2016, Toray launched Proactive Management Program (PMP) by Daily Management as a group-wide initiative. Under AP-G 2013, the operating income target was missed, with fluctuating market conditions among the external factors. Internal factors were also to blame as Toray was unable to achieve self-imposed tasks as planned, including expansion of sales of products with high added value and new product development. Toray initiated the PMP after reflecting on these shortcomings and referencing the case examples of Penfabric Sdn. Berhad (PAB) in Malaysia and TPA in the U.S. When their earnings deteriorated for various external and internal reasons, PAB and Toray Plastics (America), Inc. (TPA) had carried out fundamental reforms that resulted in dramatically improved earnings. The PMP was activity that

sought to firmly entrench daily implementation of the PDCA cycle for profit improvement through highly accurate daily monitoring and sharing of key production and sales, and management indicators.

AP-G 2016 Achievements

GR Project achievements include:

- In the carbon fiber composite materials business, Toray reached a basic agreement with the Boeing Company about supplying carbon fiber prepreg as a material for the main wings of a new aircraft, the Boeing 777X, signing a memorandum of understanding in November 2014. A comprehensive long-term supply agreement was entered in October 2015, extending the existing agreement to supply carbon fiber composite materials for the Boeing 787 to include the Boeing 777X. The total value of materials to be supplied to the Boeing 787 and 777X is expected to exceed 11 billion U.S. dollars (1.3 trillion yen based on the exchange rate at the time).
- Toray started supplying carbon fiber material selected for Toyota Motor Corporation's 'Mirai' fuel cell vehicle, launched in December 2014, and another fuel cell vehicle, Honda Motor Co., Ltd.'s 'Clarity Fuel Cell,' launched in March 2016.
- Design, prototype production, and mass production requests received by TCM and CMTH jumped after



Joint press conference with Boeing (November 2014)

they joined the Toray Group following their purchase in April 2013. Therefore, TCM constructed a new building in December 2014 to expand prototype and low-volume production functions, while CMTH built a new integrated mass production plant covering operations from molding through to coating, with work finishing in February 2016.

- Through M&A activity in January and September 2015, Toray acquired carbon fiber woven fabric and prepreg production and distribution bases in Italy, establishing an integrated supply chain for carbon fiber composite materials in Europe
- Zoltek in the U.S. doubled the large tow carbon fiber production capacity of its Mexico plant in April 2016 so that it reached 5,000 tons annually. In February 2017, a plan to double annual production to a little over 10,000 tons by the end of 2017 was announced.
- In the battery materials business, Toray actively bolstered lithium-ion BSF facilities in Japan and Korea, and acquired BSF coating equipment from LG Chem, Ltd. in Korea in August 2015.
- Toray purchased a company that develops, produces and distributes materials for fuel cells and water electrolysis systems in Germany, and set up Greenerity GmbH (GNT) in July 2015.

LI Project achievements include:

- Deployment of "hitoe," a functional material capable of continuously collecting physiological data simply by wearing it, began in fiscal 2014 with applications in training support services, followed by worker monitoring service applications in August 2016, and medical applications in September 2016.
- PP spunbond facilities were expanded in China, Indonesia, and Korea.

Toray also decided to install PP spunbond development equipment at its Shiga Plant, announcing the move in March 2017.

- In the pharmaceuticals and medical products business, Toray was granted permission to manufacture and sell a catheter ablation system for treatment of paroxysmal atrial fibrillation in November 2015, and was given approval to begin clinical trials of a cancer drug in the U.S. in February 2017.



Garment made with hitoe

AE-II Project achievements include:

- Establishment of a fourth PP spunbond machine in China (December 2014) and a joint venture for MBR water treatment membranes (June 2016)
- Making and announcing a decision to establish a sixth PP spunbond machine in Korea (June 2016; operations scheduled to begin in 2018)
- Establishment of a second PP spunbond machine in Indonesia (September 2016)
- Making and announcing a decision to establish a new integrated carbon fiber and prepreg production facility in a new business zone in South Carolina, in the U.S. (November 2015; production scheduled to begin in 2018 or later in line with demand expansion)
- In Mexico, (1) commencing resin compound production (February 2015); (2) bolstering large tow carbon fiber facilities (April 2016), and making and announcing a decision to further bolster facilities (February

2017; production scheduled to begin in late 2017); and (3) making and announcing a decision to establish a new integrated plant for automobile airbag fiber and fabric (July 2016; production scheduled to begin in 2018)

- Commenced production of automobile airbag fabric in India (October 2016)
- Commenced production of RO membrane elements in Saudi Arabia (April 2015)

In the TC-III Project, Toray reduced variable and fixed costs by a combined 194.9 billion yen over the three years 2014 to 2016, almost reaching the project target.



Opening ceremony for the automobile airbag fabric plant of Toray Kusumgar Advanced Textile Private Limited (TKAT) in India (February 2017)



Signing ceremony for the establishment of a water treatment membrane joint venture with Abunayyan Holding of Saudi Arabia (February 2014)

• Transition of Earnings (FY2014–2016)

Over the three fiscal years 2014 to 2016, the global economy was generally firm, following a trend of moderate expansion. The Japanese economy returned to a recovery trend from autumn 2014 after a longer-than-expected slump in demand resulting from a hike in the consumption tax rate from five to eight percent that took effect in April 2014. A moderate

recovery continued on the back of not only strong exports, but also factors including an increase in capital investment revolving around rationalization and labor-saving efforts.

In this business environment, Toray's consolidated earnings progressed well according to plan. In fiscal 2014, net sales broke through the two trillion yen mark for the first time and all profit indicators hit new all-time highs. Operating income came to 123.5 billion yen. Net sales and profit records were broken again in fiscal 2015, with operating income reaching 154.5 billion yen. Having broken the two trillion yen mark for net sales and making it to the 150 billion yen range for operating income, it could be said that the Toray Group had entered a new growth phase along the road toward realization of Vision 2020. In fiscal 2016, too, Toray actively pursued business expansion in growth business fields and regions, and bolstering of competitiveness in the final fiscal year covered by AP-G 2016, but the Japanese yen was even stronger against major currencies than in the previous year and earnings were therefore affected by drops in sales and profit of overseas subsidiaries after conversion into yen. As a result, net sales came to 2.026 trillion yen and operating income came to 146.9 billion yen in consolidated results, representing year-on-year sales and profit declines. Net income, however, increased from the previous year to 99.4 billion yen, a new record, due, for example, to a drop in tax expenses.

Internal Controls and Governance

As globalization of the economy continued, Toray was strongly advised of the need to establish rules for the entire Toray Group, including subsidiaries, and to strengthen governance.

In fiscal 2016, Toray adopted a group-wide system for self-inspection and mutual inspection of internal controls. Complementing already existing controls performed by operations managers, monitoring by administrative staff at Head Office and other locations, and internal audits by the Auditing Department, this inspection system was meant to strengthen cross-organizational risk management within the Toray Group and improve business processes.

In addition, revisions to Japan's Companies Act incorporated provisions relating to corporate governance urging the appointment of outside directors. This was followed by the formulation of the Corporate Governance Code, which has applied to listed companies since June 1, 2015. Contributing to communities has been a corporate philosophy right from the outset for the Toray Group, which put in place and strengthened a governance system in line with one of its Corporate Guiding Principles: "Obtaining the trust of society and meeting the expectations by acting fairly while maintaining high ethical standards and a strong sense of responsibility and maintaining transparency in management." To reflect the intentions of the Companies Act revisions, which would come into force in May 2015, and the Corporate Governance Code to be applied to listed companies in June, Toray appointed its first outside director in June 2014 (an additional outside director was appointed in June 2015; as of July 2017, Toray has two outside directors) and further enhanced its governance framework through other moves, such as setting up the Governance Committee in December 2015. The Governance Committee provides an advisory function to the Board of Directors on all matters tabled relating to corporate governance. Members are the company's chairman and president, and multiple outside directors. An outside director is selected to chair the committee.

A Foundation for Sustained Growth—Formulation of AP-G 2019 (FY 2017–2019)

In February 2017, Toray announced the third stage of its Vision 2020, a new mid-term management program, Project AP-G 2019, launching it in April.

AP-G 2019 specifies three basic strategies and five key initiatives. The first basic strategy is business expansion in growth business fields, which will continue to be advanced through existing GR and LI group-wide projects. The second basic strategy is expansion and advancement of global business, which is to be pursued through the Asia, the Americas, Europe, and Emerging Regions (AE) Project, revamping the AE-II Project from AP-G 2016 to cover all overseas business, including Europe. The third basic strategy is strengthening competitiveness, to be implemented as before through the Total Cost Reduction (TC) Project.

The five key initiatives are (1) new business creation; (2) R&D and intellectual property; (3) capital investment; (4) M&A and business alliances; and (5) human resources. One of the initiatives, R&D and intellectual property, involves a plan to invest 220 billion yen in R&D expenses over three years with half to be allocated to green innovation and one quarter toward life innovation. The plan for capital investment is to spend 500 billion yen over three years, allocating around 60 percent to growth fields and, by region, around 60 percent outside Japan.

Toward 100 and Then 200 Years

In his speech during a ceremony held at the Shiga Plant in April 2016 to commemorate Toray's 90th anniversary, President Nikkaku talked

about fundamental aspects of Toray management, including research and technology development efforts, global management, management with a view to the long term, management built around people, self-improvement, and a hands-on approach. He concluded with the following.

“The Toray Group is an advocate of the idea that ‘materials have the power to intrinsically change society.’ As a manufacturer of materials, it has been Toray’s management approach, upheld over all these years, to develop... and supply innovative materials that change the world, and in doing so, to win through, contributing to society while prevailing over competitors... Naturally, we have to make steady progress toward realizing our immediate financial targets, but instead of being easily swayed by share price fluctuations over the short term, it is important, from a mid-to-long-term outlook, to pursue gains in corporate value. I am not, by any means, saying that western ways are bad, but Japan has its very own social backdrop, norms, employment practices, and corporate history and we should not, without correctly understanding this intrinsic nature, let ourselves simply drift with the times, engaging in a style of management whereby only superficial results are appraised... Using the merits of a Japanese style of management based on high ethical standards effectively to our advantage, we will continue to develop our business worldwide, bearing in mind that we should adapt to the times based on a long-term vision, identifying the real nature of matters rather than simply



90th anniversary ceremony (April 15, 2016)

going along with the trends of the day... Remembering the Corporate Philosophy of the Toray Group—‘Contributing to society through the creation of new value with innovative ideas, technologies and products’—and that we wish to realize it for our stakeholders, the Toray Group will make every effort to remain a corporate group respected the world over, achieving sustained growth through to our centennial, and then our bicentennial years.”

Chapters 7 and 8 respectively elaborate on the Toray Group’s global business expansion and research and development.



Toray Advanced Materials Exhibition 2016
(October 2016)

Chapter 7

Global Business Expansion

Start of Overseas Business Expansion (1955–1970)

- **First Overseas Business Established: Trilon Co., Ltd. (Hong Kong)**
With a strong focus on exports since its time with rayon, Toray has made the development of overseas markets a central pillar of its business development. Nylon and polyester synthetic fibers made their appearance in the 1950s, and as production increased and costs reduced, demand also grew in a cycle that led to further production growth. For Toray, this dramatically increased the importance of its export business. Toray stationed employees in regions to which it shipped large volumes of exports as part of an active export promotion strategy. At this time, Toray outsourced its customer development and business operations to trading companies, and only focused on exporting orders for its products produced in Japan and providing technological services to overseas customers. It did not conduct any direct sales activities.

In 1955, Toray established trading company Trilon Co., Ltd. in Hong Kong, in a joint venture with a Japanese trading company and five overseas

Chinese businessmen, as its first step toward building an overseas operation involving capital contribution. Trilon was established on the belief that Toray needed its own sales company if it wanted to capture a competitive position in the Hong Kong market, and management was entrusted to the local operation. Although it was to merge into Toray Industries (H.K.) Ltd. (THK) in 1990, Trilon became a precedent to follow as the Toray Group's overseas trading network took shape during the 1980s.

• **Launch of Overseas Manufacturing Business**

In the 1960s, developing countries started adopting import substitution industrialization policies in an effort to develop their own fiber processing industries. In order to maintain its export trading rights, Toray set up joint venture businesses with local capital in the areas of spinning, weaving and knitting, dyeing, and sewing. From its first venture in the establishment of a nylon textiles company in Ceylon (now Sri Lanka) in 1962, Toray expanded to 40 companies in 17 countries globally by 1973. Since then, it has withdrawn from many of those companies.

Toray's first full-scale manufacturing business overseas was Thai Toray Textile Mills Co., Ltd. (TTTM), a manufacturer of polyester/rayon blended woven fabric in Thailand that it jointly established in 1963. At

the time, Toray's "GOLDEN EAGLE" brand of polyester/rayon blended woven fabric was very popular in the Thai market. TTTM took over production of the brand and launched an integrated spinning, weaving, and dyeing operation. In 1963, Toray established Toray Nylon Thai



TTTM (Thailand)

Co., Ltd. (TNT) (now Thai Toray Synthetics Co., Ltd. (TTS)) in a joint venture with Mitsui & Co., where it started a nylon filament yarn operation in 1967.

In Indonesia, Toray cooperated with the government's policy on developing a national fibers and textiles industry. As shown in table 7-1, it established a string of joint venture companies in the 1970s. As Toray's core company supplying nylon filament yarn to Indonesia's domestic market and polyester staple fiber to the Group's spinning and weaving companies, P.T. Indonesia Toray Synthetics (ITS) was established in the Tangerang area to the west of Jakarta, and its integrated polymerization and spinning plants for those products were constructed.



ITS (Indonesia)

Table 7-1 Toray's Presence in Indonesia (1970-1973)

Company Name	Business Type	Establishment
P.T. Century Textile Industry (CENTEX)	Polyester/cotton spinning, weaving, and dyeing	May 1970
P.T. Texfibre Indonesia (Texfibre)	Nylon, polyester filament texturing	August 1970
P.T. Indonesia Synthetic Textile Mills (ISTEM)	Polyester/rayon spinning, weaving, and dyeing	August 1970
P.T. Indonesia Toray Synthetics (ITS)	Nylon filament, polyester staple fiber, polymerization	October 1971
P.T. Acryl Textile Mills (ACTEM)	Acrylic spinning and dyeing	April 1973
P.T. Easterntex (ETX)	Polyester/cotton spinning and weaving	June 1973

In Korea, on the other hand, Toray provided woolly nylon processor Korea Nylon Inc. with manufacturing technologies and management guidance in 1963, with a capital participation coming later in 1971. In 1969, it established Korea Polyester Inc. in a joint venture with a local capital company and Mitsui & Co., while a merger between the two companies in 1981 resulted in what is now Kolon Industries, Inc. Also, in a joint venture with Samsung Group and Mitsui & Co. in 1972, it established Cheil Synthetic Textiles Co., Ltd. (name changed to Saehan Industries Inc. in 1997) for the purpose of producing polyester staple fiber.

Expansion of Overseas Business (1971–1986)

• Initiative with the TAL Group

In the 1970s, Japan's fibers and textiles industry faced serious changes in the form of a strong yen following the Nixon shock, and export controls from the Japan-U.S. Textile Agreement and the Multi-Fiber Arrangement (MFA). Limits to growth in production volumes started to appear with a gradually maturing of the domestic market and stagnation of exports. At this time, Toray explored international strategies based on new approaches, in addition to expanding its range of value-added products, as a new direction for its synthetic fiber business.

One of those strategies was implementation of a project in partnership with Textile Alliance Ltd. (TAL). TAL was jointly established in 1962, at a boom-time in the fibers and textiles industry in Hong Kong, by spinning business owner C. C. Lee and trading company Jardine Matheson & Co. TAL conceived a grand vision with operations spreading from upstream synthetic fiber manufacturing to downstream sewing,

in addition to the midstream spinning, weaving, and dyeing at its affiliates. Dividing its production across free trade zones for optimal efficiency, it would sell the finished garments in the United States and Europe. At the core of its operations were polyester/cotton blended fabrics, while its main garments were dress shirts.

With its technological and financial strengths, Toray was the perfect partner to TAL. With both companies in agreement, Toray invested in TAL in 1971. In 1973, Toray and TAL jointly established Penfibre Sdn. Berhad (PFR) in Malaysia's Penang state as a manufacturer of polyester staple fiber. Together with spinning, weaving, and dyeing companies already established in Malaysia by TAL, the country became Toray's integrated production site for everything from staple fiber to polyester/cotton blended fabrics. Other joint ventures for the partnership included a capital participation in Luckytex (Thailand) Company Limited (LTX) in Thailand in 1972, and establishment of P.T. Easterntex (ETX) in Indonesia in 1973.

• TAL Group Restructuring

In the midst of these developments, the first oil crisis struck in 1973 and tripped up Toray's plans. It set back its exit strategy, of direct sales of its own garment brands to mass retailers and major apparel stores in the West, as each TAL Group manufacturing site fell into the red. With financial support and an increased shareholding ratio, Toray had to participate directly in TAL Group management. It sent a senior sales & marketing executive and other staff to help restructure the business in 1976. After that, TAL successfully changed direction to become an OEM producing garments under client companies' brands. Back in the black in

fiscal 1978, the company was able to eliminate its accumulated losses by fiscal 1980.

After this train of events, Toray led the restructuring of the TAL Group in 1983. Toray took 100 percent ownership of upstream (staple fiber) and midstream (spinning, weaving, and dyeing) businesses, while C. C. Lee led a new company to manage downstream (sewing) businesses and TAL retained the remaining Hong Kong knitting business. In a second restructuring in 1990, Toray ceased involvement in TAL and took PFR, PAB (Penfabric Sdn. Berhad), LTX, and ETX under its wings as subsidiary companies.

Including the TAL Group, Toray's companies with manufacturing sites in Southeast Asia continued their decline into the red as economies stagnated on the back of oil crises in the 1970s and a simultaneous worldwide slump. During the 1980s, Toray again and again considered the disposal or liquidation of its overseas companies. Instead, it improved its cost competitiveness and achieved export quality through business structure reform and production technology improvements at each company, with their products outdoing Korean and Taiwanese products in Western markets. It was at this time that the cost competitiveness of products from Toray's Southeast Asian companies took a big jump forward through a currency alignment under the Plaza Accord. As a result, the companies have achieved stable profits since fiscal 1986.

• Business Expansion into Western Countries

Toray's expansion into the West started with the manufacture and sale of a suede-texture artificial leather in 1971. (This was selling in Japan at the time under the "Ecsaine" brand.) With demand focused on Western

countries that were familiar with leather apparel, Toray marketed this product in the United States through leading converter Spring Mills Inc. under the brand name "Ultrasuede."



Alcantara (Italy)

In the meantime, Toray and Italian synthetic fiber company Azienda Nazionale Idrogenazione Combustibili (ANIC) S.p.A. (now EniChem S.p.A.) established Iganto S.p.A. in Milan, Italy, in 1974, with Toray holding a 49 percent share. Iganto began producing under the brand name "ALCANTARA," and in 1977 developed an integrated production system handling everything from ultrafine staple fiber to the finished goods. In 1981, it changed its name to Alcantara S.p.A. because of the rapid sales growth its ALCANTARA products were experiencing on the back of high popularity in the market. Toray acquired management rights for the company in 1991.

In France in 1980, the government enthusiastically solicited the production of carbon fiber, which it regarded as an important material for the aerospace industry. To quickly secure its place in the European market, which had strong potential going forward, Toray decided to establish a joint venture company with state-run oil company Elf Aquitaine S.A. (now Total S.A.). In 1982, the partnership established Société des Fibres de Carbone S.A. (SOFICAR, now Toray Carbon Fibers Europe S.A. (CFE)) with Toray holding



CFE (France)

a 35 percent share, and the company started operating in 1985. Toray acquired management rights for the company in 1988.

In 1985, Toray acquired Trea Industries, Inc., a polypropylene film manufacturer in the State of Rhode Island, as a manufacturing site in the U.S. and made it Toray's first wholly-owned subsidiary (the company changed its name to Toray Plastics (America), Inc. (TPA) in 1989). Trea quickly built a new plant where it started production using Toray's technologies. Later, it started producing metalized products and finally expanded its product range to include polyester film.

Advance of Globalization (1987–1996)

- **Globalization of the Fibers and Textiles Business**

In line with its belief that “fibers and textiles are a growth industry for the world,” Toray started expanding its polyester filament business lines globally at the end of the 1980s, adding to its polyester staple fiber lines already expanding throughout the ASEAN region.

It put a number of plans into action, including transferring existing facilities from its Mishima Plant to ITS in Indonesia and producing polyester filament yarn in 1990, producing polyester taffeta fabrics, a standard product type used as lining material, at LTX in Thailand in 1989, and establishing Toray Fibers (Thailand) Ltd. (TFL, now TTS) and producing polyester filament yarn using an innovative one-step process in 1991. After Courtaulds Ltd. of the United Kingdom approached Toray about the disposal of its polyester filament textile business, Toray acquired Samuel Courtauld & Co., the polyester filament textile division of Courtaulds, and established Toray Textiles Europe Ltd. (TTEL) in

1989. Following the acquisition, it built a new plant in Mansfield to produce light-weight polyester fabric and started operation in 1993.

With its polyester staple fiber lines as well, together with capacity increases at ITS and PFR, Toray Group companies in ASEAN countries updated the looms to high-efficiency air jet looms (AJL) while also modernizing spinning, dyeing and other equipment and dramatically expanding capacity at these facilities. As a result, Toray's polyester/cotton blended fabrics operations in the ASEAN region became world-leading in terms of both production volumes and quality.

Because of the strong growth of its businesses in the ASEAN region, Toray was able to devote itself to its social contribution activities. Like in Japan, it established a local Toray Science Foundation in Malaysia, Indonesia, and Thailand in 1993 and 1994, and held its first presentation ceremonies in 1995.

- **Building an Integrated Fiber Business in Nantong, China**

Toray's involvement with China goes back to the 1950s and includes export of fiber and textile products, and export of synthetic fiber plant and technologies. However, even in the 1980s, it was still maintaining a wait-and-see approach to direct investment. In the 1990s though, with China attempting to adopt a socialist market economy, Toray also changed direction and provided technological assistance to a dyeing project in China's Shaanxi Province, with capital participation by THK. Because the deal involved a semi-government corporation in mainland China, Toray conducted research on China's “one country, two systems” principle, and the situation with its corporate management, in preparation for a full-scale investment.

It formulated a business plan to build an integrated production system for polyester filament yarn in China, handling everything from polyester polymerization and spinning to weaving and dyeing, and then started researching a location. In 1994, Toray selected a location from several options. It secured a million square meters of land in the Nantong Economic & Technological Development Zone, Nantong, Jiangsu Province, which boasted favorable conditions combining existing water, electricity and other infrastructure, a booming fibers and textiles industry, a highly-educated and extremely capable workforce, and favorable treatment of foreign companies. In August 1994, Toray and Sakai Ovex Co., Ltd. jointly established Toray Sakai Printing & Dyeing (Nantong) Co., Ltd. (TSD) as a polyester filament textile dyeing company, and then in 1995 they also established Toray Sakai Weaving (Nantong) Co., Ltd. (TSW) as a supplier of textiles to TSD. Also in 1995, Toray established Toray Fibers (Nantong) Co., Ltd. (TFNL) as a polyester polymerization and spinning company to complete a totally integrated system of production.



TSD (China)

- **Globalization of Businesses Other Than Textiles**

Resins Business: Along with the Nantong fibers and textiles project, Toray started to move into the rapidly expanding China market. Targeting the surging production of home appliances, office automation equipment and game machines, Toray established a number of

companies in 1995 producing acrylonitrile butadiene styrene (ABS) and other resin compound products (sales company LIBI Plastic Compounding (Hong Kong) Co., Ltd. (LCH), manufacturing company LIBI Plastic Compounding (Shenzhen) Co., Ltd. (LCS)), and molded and assembled products (sales company Toray Sanko Precision (Hong Kong) Ltd. (RKH), manufacturing company Toray Sanko Precision (Zhongshan) Ltd. (RKZ)). Considering convenience, tax advantages, and other issues, it located its sales sites in Hong Kong, created separate entities for its manufacturing sites, and located them in the Shenzhen Special Economic Zone and Zhongshan Development Zone in mainland China. On the other hand, Toray had started resin molding in Malaysia prior to its China operations, so in 1990 it followed up by establishing Toray Plastics (Malaysia) Sdn. Berhad (TPM) on PFR premises to produce “Toyolac” ABS resin. As its first overseas resin polymerization site, Toray started production in 1992 and since then has continued a program of facility enhancements. In the U.S., Toray established the Montor Performance Plastics Company in 1989 as a joint venture with the Monsanto Company, and started a nylon resin compounding business. The business was transferred to Toray Resin Co. (TREC) in 1999.



TPM (Malaysia)

Films Business: In 1988, Toray established and started operating 3TM Plastics Co., Ltd. (3TP, now TTS) as the first metalized products company in Asia. The following year, it enhanced the facility to enable integrated production from the base film stage. In the meantime, in the U.S., TPA had



TPA (United States)

already started producing “Torayfan” polypropylene film. In 1991, it also started producing “Lumirror” polyester film and continued expanding capacity along with growth of the Torayfan business until 1997, when it started producing the new “Toraypef”

polyolefin foam as well. With the local community holding high expectations for TPA, the company established the Toray Plastics (America), Inc. Scholarship Endowment in 1992 to commemorate the 100th anniversary of the University of Rhode Island and to contribute to the community. Each year, interest from operating the fund is used as the scholarship capital provided to scholarship recipients. TPA provided additional support later by endowing a graduate level scholarship of one million U.S. dollars (95 million yen) in 2010, and then providing sponsorship of a new Engineering Facility for two million U.S. dollars (200 million yen) in 2014.

Carbon Fiber Composite Materials Business: Toray’s “Torayca” prepreg carbon fiber composite material is the only primary structure material used on Boeing 777 aircraft. For this reason, Toray established prepreg manufacturing company Toray Composites (America), Inc. (TCA, now Toray Composite Materials America, Inc. (CMA)) on land adjacent to the Boeing Company’s Tacoma plant in the suburbs of Seattle, Washington State, in 1992. After starting operations in 1994, TCA went through a series of capacity expansions as demand grew. With the acquisition of management rights of SOFICAR in 1988, Toray had developed a three-zone system for its carbon fiber composite materials business, in Japan, the U.S., and Europe.

• From Globalization to Global Operations

As the scale of Toray’s overseas production increased with its push for globalization, it became necessary to look at optimizing operations for the whole Group. Examples of this were division of items according to specialized product types, adjusting operation in each region in line with strong or weak demand, from domestic to overseas, overseas to domestic, or overseas to overseas, and connecting optimal production and processing sites in the vertical operation (from filament to textiles to garments) of the fibers and textiles business. Calling this approach *global operations*, Toray sought to minimize costs through optimization of production, distribution and sales channels, and to avoid business situations it could not handle alone, and the effect of foreign exchange fluctuations.

To enable global operations, each product of Toray Group companies required the same “Made *in* Toray” quality standard regardless of which country or which plant they were made. To achieve this, Japanese plants took the role of *mother plants* and focused on transferring technologies and creating uniform production technologies. In this way, Toray’s globalization evolved into global operations for each of its fibers and textiles, resins, films, and carbon fiber composite materials businesses.

• Trading Activities

In the middle of the 1980s, the export and marketing power of general trading companies began to decline, which required Toray to compensate for the decline and provide export support to its active companies in the ASEAN region. Toray also had to expand its manufacturer/trading company function to facilitate the global operations it launched in the 1990s, and to help drive its carbon fiber composite materials business,

and water treatment membrane business, that were focused on overseas markets and required specialist knowledge. Toray's trading activities included changing the status of its existing representative offices to local subsidiaries, establishing Toray Industries (America), Inc. (TAM) in the U.S. in 1965, THK in Hong Kong in 1974, and Tong Shing Inc. in Taiwan in 1980, while restructuring and reorganizing existing companies and establishing new ones. It also established Toray Europe Ltd. (TEL) in the U.K. in 1980, Toray Industries (Singapore) Pte. Ltd. (TSP, originally TIA) in 1982, Toray Deutschland GmbH (TDG) in Germany in 1985, and Toray Marketing and Sales (America), Inc. (TOMAC) in 1988 by spinning off the trading function from TAM. In 1989, Toray changed the general shareholder composition of each trading company to 70 percent Toray ownership and 30 percent Toray International, Inc. (TI) ownership. As its overseas trading activities later expanded, it became necessary to strengthen ties with TI and the rest of its trading function, and in 2007, Toray returned the general shareholder composition of those companies to 70 percent TI and 30 percent Toray as part of another restructuring that included name changes for a number of companies.

Rapid Expansion of Overseas Business (1997–2006)

- **Full-scale Investment in China**

Fibers and Textiles Business: TSD and TSW were in production when in 1998 they doubled the capacity of their production facilities. In 2000, they merged to form a new TSD (Toray Sakai Weaving & Dyeing (Nantong) Co., Ltd.). They continued to expand capacity and in 2004 had roughly ten times their original production capacity, including nylon

filament textiles, which started later. Meanwhile, TFNL had started polyester polymerization and spinning in 1998 using a state-of-the-art facility employing the best of Toray's technologies. However, due to continued capacity expansion with low-cost Chinese-made equipment, the company fell into the red in a chronically oversupplied China market. To resolve the issue, it installed batch processing equipment able to produce specialty products, and then installed nylon filament yarn facilities in 2005.

With the business growing, Toray established Toray Fibers & Textiles Research Laboratories (China) Co., Ltd. (TFRC) in 2002 for the main purpose of developing new products tailored to local needs. As one of Toray's global research sites, TFRC conducted research and technology development covering the full range of polymer chemistry and fiber technologies. In 2004, it opened a Shanghai branch to develop advanced polymer materials. The branch became Toray Advanced Materials Research Laboratories (China) Co., Ltd. (TARC) in 2012.

Resins Business: In 2002, Toyo Plastics Seiko Co., Ltd. (now Toray Plastics Precision Co., Ltd.) established Shanghai TPS Precision Co., Ltd. (STPS) and started supplying small precision structural components. In the following year, LCS (now Toray Plastics (Shenzhen) Ltd. (TPSZ)) installed compounding equipment for polyphenylene sulfide (PPS) resin. In 2005, Toray dissolved the joint management of LCH (now Toray Plastics (China) Co., Ltd. (TPCH)) and established its wholly-owned Toray Plastics (Hong Kong) Ltd. (TPHK). Positioning TPHK as its resin compounding business headquarters in South China, with production companies under its control, it was able to centralize its production, sales and technical services functions and develop an efficient business

management system. Then in 2006, it established Tianjin Pigment Engineering Plastics Co., Ltd. (NPT) in North China's Tianjin in a joint venture with Nippon Pigment Co., Ltd. and Toyota Tsusho Corporation. It also acquired an existing company in East China's Suzhou and established a new company (now Toray Plastics (Suzhou) Co., Ltd. (TPSU)), which completed its structure spanning South, East, and North China.

Films Business: In 2001, Toray established Yihua Toray Polyester Film Co., Ltd. (YTP) in Yizheng City, Jiangsu Province, in a 50-50 partnership with Yihua Group Co., an affiliate of the China Petrochemical Corporation, to manufacture and market polyester film. YTP purchased Yihua Group Co.'s existing equipment and started operation. Growing in size, it expanded capacity of its production facilities for packaging and industrial materials in 2004, and its production equipment for ultra-thin polyester films for capacitors in 2006.

During this period, Toray was providing indirect support for its business expansion in China while working to raise awareness of the Toray brand. In 1997, Toray became a special sponsor of the Shanghai International Marathon, which it still continues today. In 2003, Toray launched its prestige brand "Torex" simultaneously in Japan and China with outdoor signage and television commercials.

- **Establishment of Toray Saehan Inc. in Korea**

In 1997, Cheil Synthetic Textiles Co., Ltd., which had diversified and separated from the Samsung Group, changed its name to Saehan Industries Inc. However, after taking a direct hit from the Asian financial crisis spreading across markets at the time, it needed to enter a work-out program to improve its financial health. Toray was asked by Saehan

Industries to provide support, so the two companies jointly established Toray Saehan Inc. (TSI, now Toray Advanced Materials Korea Inc. (TAK)) in 1999. TSI proceeded to buy all of Saehan Industries' polyester film business and nonwoven fabrics business, and part of its polyester filament business, and started operation in December 1999. TSI then expanded its polyester film capacity, started a film coating business, expanded capacity of its polypropylene filament nonwoven fabrics (PP spunbond) business for disposable diapers and expanded the business overseas. In 2010s, it expanded into the carbon fiber and PPS resin business domain. Meanwhile, in 2008, Toray made TSI a wholly-owned subsidiary and then changed its name to TAK in 2010.

In 1995 in Korea, prior to the establishment of TSI, Toray and the Samsung Group had also established STEMCO, Ltd. for forming flexible electronic circuits and leads on polyimide (PI) film, and STECO, Ltd. for mounting driver ICs. With strong growth in these businesses, STECO was relocated to a new plant in Cheonan in 2003, followed by STEMCO relocating to Ochang in 2005. While having STECO as its largest customer, STEMCO also supplied products to other semiconductor companies and grew to become the manufacturer with the leading share of the global market.



Signing ceremony for joint venture between Toray and Saehan Industries (June 1999)

- **Actively Advancing Globalization in Every Region**

Czech Republic: In 1997, Toray established Toray Textiles Central Europe s.r.o. (TTCE) in the Prostějov industrial zone of the Czech Republic and started an integrated production system for weaving and dyeing polyester taffeta fabrics. As Toray's first business site in Eastern Europe, TTCE continued to enhance its facilities and actively expand its business, including starting production of airbag fabrics in 2006 and "Toray Waterless Plate" in 2013.



TTCE (Czech Republic)

Malaysia: In 1998, Toray started producing Lumirror at its PFR operation, where it expanded capacity to three machines by 2006 and started aluminum metalization in 2014. It also established Toray BASF PBT Resin Sdn. Berhad (TBPR) in 2004 in a 50-50 partnership with Germany's BASF SE to produce polybutylene terephthalate (PBT) resin. It started production in 2006 and sold products under both parent company brand names.

France: In 1996, Toray acquired a polyester film subsidiary of Rhône-Poulenc S.A. and established Toray Plastics Europe S.A. (TPEU). It installed a new production line using Lumirror technologies and started production in 1999. In 2010, in order to improve management efficiency, it transferred equipment from TPEU to Toray Films Europe S.A.S. (TFE), a company established in 2008 to manufacture Torayfan.

U.S.: Following the establishment of its prepreg manufacturer TCA in 1992, Toray established Toray Carbon Fibers America, Inc. (CFA, now

CMA) at Decatur, Alabama in 1997 to produce carbon fiber. It started production in 1999. In 2004, Toray installed new precursor production equipment and expanded the capacity of its carbonization facility to complete an integrated precursor, carbonization and prepreg production system in the U.S. It continued to expand capacity afterward as well.

In 2001, Toray obtained management rights of a U.S. company with 50 percent share of the global market in PPS fiber. In 2002, it also acquired a fluorofiber business from DuPont and secured usage rights for the extremely well-known 'Teflon' brand name. With these and other developments, it drove a program of mergers and acquisitions in the area of high-performance fibers.



TCA (now CMA) (United States)



Ground breaking ceremony for South Carolina plant of CFA (now CMA) (January 2016)

- **Establishment of Regional Supervisory Organizations**

In 2002, Toray reformed its businesses in every sector through implementation of its NT21 companywide mid-term management program. At the same time, it continued strengthening its globalization plans. It also introduced a regional supervisory organization system to enable decisions to be made quickly and autonomously, and to take advantage of the high rates of economic growth in some regions to expand its own businesses.

Again in 2002, it established separate headquarters in China, Indonesia, Thailand, and Malaysia, and gave each president decision-making authority for capital investment. Exceeding that of divisional general managers, this authority was on the level of Toray's president.

- **Global Re-Engineering**

As Toray's overseas investments continued, its overseas production sites multiplied, and their production capacity grew. With the addition of TSI, itself a large company, to the Group, clarifying the roles of each production site, and transferring and remodeling existing production facilities, and establishing new facilities, Toray aimed to carry out production and marketing of each product in the most appropriate locations. Toray called this process Global Re-Engineering. Typical examples were the polyester film business (with six production bases globally) and polyester filament business (with five production bases globally), where this concept was implemented to enhance their total cost competitiveness and establish profit bases that allowed them to overcome global price competition.

Along with expansion of its overseas business domains, Toray held its Asia International Conference, and International Conference for U.S. and Europe Affiliates, in 2002 to monitor progress of that expansion. (These two conferences were combined into one in 2009.)

A New Global Expansion (2007–2016)

- **Global Strategy after IT-2010**

Toray launched its IT-2010 mid-term management program in October 2006, through which it launched an overseas business enhancement

project and expanded its businesses in growth regions. Although investment projects were limited by the global financial crisis of 2008, the policy of overseas business expansion was continued in Project AP-G 2013 as well, becoming the Asia and Emerging Country Business Expansion (AE) Project. Specifically, this entailed the establishment of bodies in China, India, ASEAN, and emerging countries to promote expansion, with the U.S. also added from AP-G 2016. Each committee, business expansion conference and other channel were tasked with formulating, promoting and monitoring regional strategies. Emerging countries prioritized through this project were India, Brazil, Russia, and countries in the Middle East, North Africa, and Central and Eastern Europe. Toray established local representative offices in each of these countries, collected local information and enhanced communication. (One example was the Toray India Representative Office it established in 2011, which was converted to the subsidiary Toray Industries (India) Private Limited (TID) in 2014.) At the same time, Toray continued its expansion of growth businesses in Europe and Korea.

In April 2017, Toray shifted to a three-dimensional global management matrix with the business dimension, regional dimension, and functional dimension on each axis. Decision-making authority for capital investment, etc. was also transferred to divisional general managers.

- **Business Expansion in China, a Massive Growth Market**

Fibers and Textiles Business: With TSD establishing itself as a profitable entity, Toray proceeded to expand its capacity, give it responsibility for its own business operations, and implement other ideas rooted in the production and sales workplace. Year by year, it was able to further grow

its profits, becoming a preceding model for other Toray Group companies in China. TFNL also grew on the back of its specialty product lineup, turning profitable in 2010 and entering a new phase of expansion. With growing demand for disposable diaper applications, Toray Polytech (Nantong) Co., Ltd. (TPN) was established on its Nantong premises in 2006 to produce PP spunbond nonwoven fabrics through a technology transfer from TSI. The new company experienced strong growth since starting production in 2008, and expanded capacity to four machines by 2014. In 2017, Toray Polytech (Foshan) Co., Ltd. (TPF) was also established in Foshan, China.

Resins Business: In 2010, Toray restructured Toray Plastics (China) Co., Ltd. (TPCH, renamed from TPHK) to become its resins business headquarters for the whole of China. While strengthening its unified production and sales operations, it established a new plastics technology center at TPSZ in Shenzhen to centralize its development and technical services. In 2012, Toray established Toray Plastics (Chengdu) Co., Ltd. (TPCD) in Chengdu, Sichuan Province, to make inroads into inland China. Then in 2013, it installed compounding equipment for Torayca resin at TPSZ.



TPCD opening ceremony (December 2013)

Films Business: To meet surging demand for flat panel displays, Toray transferred its Japanese polyester film production facilities to YTP in 2011. Installing the latest facilities in 2015 as well, it expanded its optical film business.

Chemicals Business: In 2009, Toray Fine Chemicals Co., Ltd. established Cangzhou Toray Fine Chemicals Co., Ltd. (TFCC) in Cangzhou, Hebei Province, to manufacture dimethyl sulfoxide (DMSO). This chemical was used in semiconductor manufacturing and other processes and was expected to see growing demand for medicine and agricultural chemical applications.

Water Treatment Business: In 2009, Toray and China National BlueStar (Group) Co., Ltd., an affiliate of the China National Chemical Corporation, jointly established Toray BlueStar Membrane Co., Ltd. (TBMC) in Beijing to manufacture water treatment membrane products. In 2016, Toray and Jiangsu Water Business Doctor Co., Ltd., a member of the Water Business Doctor Group, jointly established Toray WBD Membrane Technology (JS) Co., Ltd. (TWMT) in Yancheng, Jiangsu Province, to manufacture water treatment membranes used in the Membrane Bioreactor (MBR), membrane separation activated-sludge-method process.

Medical Products Business: With a growing dialysis market in China, Toray and Qingdao Jifa Group Co., Ltd. jointly established Toray Medical (Qingdao) Co., Ltd. (TMQ) in Jimo, Qingdao, Shandong Province in 2011. The company started manufacturing and marketing dialysis machines in 2012. It then started manufacturing artificial kidneys for sale in Japan from 2014, and within China from 2017.

- **Continuing Expansion of the Fibers and Textiles Business**

Due to a rapid increase in demand for disposable diapers in ASEAN countries as well, Toray and TAK established, and started production at, P.T. Toray Polytech Jakarta (TPJ) on ITS premises in 2011 to produce PP

spunbond nonwoven fabrics for disposable diapers using TAK technologies. It started up its second machine in 2016 and made the decision to expand capacity to six machines at Korea's TAK, starting production in fiscal 2018 and consolidating its position as the main supplier within Asia.

Globally, demand for automobile airbag applications continued to rise. In 2002, Toray appointed overseas sites for production—Thailand's TFL (now TTS) as its nylon filament manufacturer and LTX as its airbag fabric manufacturer. It enhanced its facility and started production, and since then has continued a program of capacity expansion. It appointed TTCE as a new airbag fabric manufacturer in 2006, and later established Toray Kusumgar Advanced Textile Private Limited (TKAT) in India in 2014 as a joint venture for airbag fabric, and started production in 2016. Furthermore, it established Toray Advanced Textile Mexico, S.A. de C.V. (TAMX) on the premises of Zoltek Companies, Inc.'s Mexico plant in 2015, with plans to start production of filament yarn and airbag fabric in 2018.

Toray's integrated materials and garments business conducted with UNIQLO Co., Ltd. has also expanded rapidly. For this reason, Toray developed and enhanced its filament and textiles production systems in

Japan and overseas, while securing and developing high quality clothing plants as its production system. With those plants opening in China, ASEAN countries and Bangladesh, THK is now functioning as a cornerstone of the Toray supply chain.



TKAT (India)

In 2014, through TAK, Toray made Woongjin Chemical Co., Ltd. in Korea a consolidated subsidiary, with the company changing name to Toray Chemical Korea Inc. (TCK). In this way, Toray was able to incorporate TCK's polyester filament yarn and staple fiber businesses into the Toray Group, and reap the benefits of synergies created. TCK also enhanced its facilities for low-melt polyester staple fiber and composite staple fiber for the nonwoven fabrics for which demand continued to increase.

- **Expansion of Resins Business Centered on Automobile, Electric and Electronic Applications**

While continuing to enhance production capacity of ABS resin at TPM, Toray was positioning PPS resin as a strategic growth material for the company. In addition to its Tokai Plant, it chose TAK as its overseas production site for the resin. It built a new integrated production line for processes from the synthesis of the main raw materials through to polymerization and compounding at the Saemangeum Industrial Complex in Gunsan, Jeollabuk-do Province in Korea. It started gradual production in 2015, starting from compounding, and solidified its position as a global leader for the Toray Group.

On the other hand, to meet the rising demand for compounding everywhere, Toray expanded capacity in China, and expanded nylon and PBT resin compounding capacity at ITS and PPS compounding capacity at TTS. It also established Toray Resin Mexico, S.A. de C.V. (TRMX) as a new production site on the premises of Zoltek's Mexico plant in 2014, where it started producing nylon and PBT resin compounds the following year.

- **Expansion of Film Business Centered on IT and New Energy Sectors**

In 2007, Toray expanded capacity for optical polyester film at TAK in Korea, while continuing to enhance its IT-related film coating production line.

Toray Advanced Film Co., Ltd. also established Toray Advanced Film Kaohsiung Co., Ltd. (TAFK) in 2011 in Taiwan as a new production site for “Toretac” self-adhesive polyethylene (PE) film, which it started producing the following year. When LEDs started being used for LCD backlight units, demand was expected to grow for this surface protection film, a functional film essential for the units.

Toray started battery separator film (BSF) business in 2010 by establishing a joint corporation Toray Tonen Specialty Separator Godo Kaisha (later Toray Battery Separator Film Co., Ltd. (TBSF)) in Japan, and then its subsidiary started production also in Korea. To accompany the business expansion, it enhanced the film production facilities for BSF at Toray Battery Separator Film Korea Limited (TBSK), a Korean subsidiary of TBSF, which was later absorbed into Toray Industries, Inc. in 2017. In 2015, it also established Toray BSF Coating Korea Limited (TBCK) when buying the separator coating equipment from LG Chem, Ltd. As a result, it built a system able to quickly respond to functional advances in separator film.

- **Active Expansion of Carbon Fiber Composite Materials Business to Meet Rising Demand**

While continuing to expand capacity at its three existing sites in Japan, the U.S., and Europe, Toray made TAK its fourth carbon fiber site to

capture the rapidly increasing demand in Asia, and in Korea and China in particular. TAK started production in 2013, after which Toray’s global expansion continued at the four sites. CFE also acquired new land where it built Toray’s third precursor production line after those in Japan and the U.S.



Zoltek (Mexico)

In 2014, Toray acquired Zoltek, the world’s largest manufacturer of large tow carbon fiber products, of which wind power blades were the main application. The company had integrated production lines for everything from precursor to carbonization in both Hungary and Mexico. Toray doubled production capacity of the Mexico plant immediately after the acquisition, and since then has been further increasing capacity at both plants.

Without a prepreg production site in Europe, Toray established Composite Materials (Italy) S.r.l. (CIT) in Italy in 2015. It acquired an existing company’s business and acquired shares in Delta-Tech S.p.A. (DELTA), making it a company subsidiary.

With a capital participation in Germany’s Advanced Composite Engineering GmbH (ACE) in 2008, followed by a joint venture establishment of Euro Advanced Carbon Fiber Composites GmbH (EACC) with Daimler AG in 2011, Toray started producing composites in Europe. In the U.S., in 2013, Toray made a capital participation in Plasan Carbon Composites, Inc. (PCC), a Tier 1 supplier of carbon fiber reinforced plastic (CFRP) components for automobiles. Toray also built a new mass production plant at Carbon Magic (Thailand), Co., Ltd. (CMTH) in

Thailand, the production subsidiary of Toray Carbon Magic, Co., Ltd. (TCM) which it had acquired and established in Japan. Construction of the plant was completed in 2016.

In 2015, Toray and the Boeing Company signed a comprehensive long-term contract for the supply of prepreg to a new Boeing 777X program, in addition to the existing Boeing 787 program. Toray obtained new land in South Carolina to supply this contract. It decided to build a new integrated production line for everything from precursor to carbonization and prepreg, and it plans to gradually start production from 2018. At the same time, Toray merged CFA and TCA in April 2017 and launched a new company called CMA as part of a plan to further expand its business through centralized management of its three sites in the U.S.

- **Expansion of Water Treatment Business to Address Global Water Shortage**

While expanding its business in China, Toray established Toray Membrane USA, Inc. (TMUS) in the U.S. in 2006, and Toray Membrane Middle East LLC (TMME) in Saudi Arabia in 2014 through a joint venture, and started production of reverse osmosis (RO) membrane elements. Having also acquired TCK in 2014, the Toray Group had five

sites globally producing RO membrane elements—Japan, the U.S., China, Korea, and Saudi Arabia. Using these production sites, global sales and marketing sites including Switzerland's Toray Membrane Europe AG (TMEu), and its R&D



TMME (Saudi Arabia)

sites, Toray implemented an integrated global expansion to provide solutions for the world's water shortage.

- **Toray's Global Business Strategy**

When locating business sites overseas, Toray is implementing a global business strategy. This entails cycles of sustainable growth on a global scale, while applying the principle of putting down roots for the long term and contributing to the economic development of each country or region where it is located. Toray achieves sustainable growth by manufacturing both in Japan and overseas.

To do this, it follows a cycle of (1) Conducting innovative research and technology development in Japan to create advanced materials, (2) Building or selecting optimal overseas sites from various perspectives, including demand and cost competitiveness, and then expanding those businesses while meeting local needs, and (3) Reinvesting the profits into research and technological development of the next advanced materials and innovative processes together with Japan's *mother plants*.

Through these efforts, the Toray Group achieved consolidated overseas net sales of 1.1 trillion yen in fiscal 2016, surpassing 52 percent of the Group's net sales. As of March 31, 2017, it also had 156 consolidated companies in 25 countries and regions worldwide, excluding Japan. The number of Toray Group's overseas employees exceeded half of its total employees in fiscal 2001, with its overseas property, plant and equipment exceeding half in fiscal 2013, and overseas net sales exceeding half in fiscal 2014. Looking at these key indicators, Toray is truly a global company in both name and reality.

Research and Development

Since its founding, Toray has worked to create innovative new technologies and expand its existing technologies based on the firm conviction that research and technology development (R&D) provide the key to building the Toray of tomorrow. From their predecessors, Toray's researchers and engineers have inherited a belief in the pursuit of the ultimate, and that drilling down deep into a topic will uncover the next new thing, as expressed in the words "The Deeper, the Newer." They also inherited the spirit of challenge to create advanced materials. Through technology integration of Toray's core technologies of organic synthetic chemistry, polymer chemistry, biotechnology, and nanotechnology, they are researching and developing technologies aimed at creating new technologies and products. This chapter looks at Toray's R&D efforts, from the past to the present, and discusses the main examples of Toray's innovative products and technologies.

Establishment of R&D Department and Research Laboratories (1927–1959)

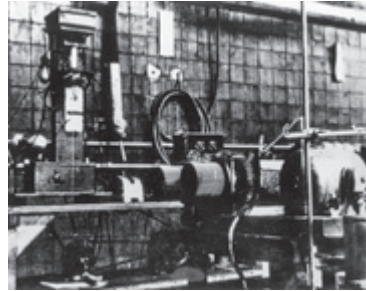
- **R&D with Rayon**

In June 1927, just prior to the start of rayon yarn production and a year after the company was founded, Toray announced its first organizational structure. Directly below the Board of Directors was the General Manager of the Shiga Plant, and below him were the Commercial Section and the Plant Department. Within the Plant Department were the R&D Section, Production Section and others. At the beginning, Japanese workers quickly digested and absorbed manufacturing technologies from a group of foreign engineers. They then worked to improve those technologies by themselves to create a range of products with world-class quality and cost. With expansion of the rayon business, the R&D Section changed name to the R&D Department in 1939 and proceeded to enhance its R&D activities.

- **Start of Nylon Research**

In 1938, DuPont of the United States announced that it had successfully developed *nylon*. The arrival of nylon heralded the dawn of an era of synthetic fibers. With the shock of this development, Toray's leadership and research team immediately started basic research into synthetic fibers. In 1939, they analyzed samples they had acquired and confirmed that nylon was a linear polymerization of adipic acid and hexamethylenediamine (nylon 66). In the same year, Toray produced these two monomers and successfully polymerized and spun nylon 66. Then in 1941, after successes including spinning multifilament nylon 6 from polymerized

caprolactam, it was able to quickly complete its basic research into nylon and obtain four patents from the results. In 1942, Toray installed test facilities at the Shiga Plant to produce nylon 6 and nylon 66. After deciding on the trade name “Amilan,” it started producing and marketing the products.



Original nylon spinning equipment (Shiga, 1943)

Without infringing on DuPont patents, Toray was able to research the industrialization of nylon by itself. It found comparative advantages of using nylon 6 over nylon 66 in the areas of equipment costs and unit material consumption, while finding almost no difference in performance, so instead of the nylon 66 that DuPont developed, Toray focused its development on nylon 6. Development had to be postponed during World War II, but immediately after the war Toray recommenced production of nylon fishing line at the Shiga Plant. Then in 1951, it started production of nylon multifilament for apparel at the Aichi Plant.

While Amilan did not infringe on DuPont’s patents, it was more convenient to use DuPont’s patents for commercial production. Therefore, later in 1951, Toray signed an (expensive) technology licensing agreement to obtain a patent license, but one that excluded technological know-how such as mechanical engineering drawings. In this manner, Toray was able to improve its production processes, including spinning and fiber drawing, while acquiring technological information to improve productivity and quality. The patent license that included fibers application processing was also useful.

• Central Research Laboratories Opened

In 1949, Toray’s R&D Department changed name to Research Laboratories (but changed back to R&D Department when the Production Division was established in 1955). In 1951, Toray established the Synthetic Fiber Research Laboratory in the newly-built Nagoya Plant to focus on stable production, quality improvement, and new product development for nylon. At the same time, it worked on developing processing technologies in partnership with fibers application processing manufacturers.

Busy researching rayon and nylon technologies in 1953, Toray made the decision to build the Central Research Laboratories to advance polymer chemistry and enhance basic research. The Central Research Laboratories were opened in 1956 with the roles of (1) Conducting research on basic issues and on common issues faced by research laboratories located in each plant, (2) Conducting research on new products not directly related to existing products, and (3) Conducting research for the future.

After signing a technology licensing agreement with Imperial Chemical Industries Ltd. (ICI) in the United Kingdom in 1957, Toray built the new Mishima Laboratory in 1958 to research industrialization of polyester fiber. It also established the Development Department in 1959, including the Teton Film Lab, Fiber-IV (acrylic fiber) Lab, Pylon Lab, and Plastics Research Laboratories (newly established the previous year within the R&D Department), and proceeded to develop technologies for new businesses.

• Main R&D Activities in the 1950s

The three major synthetic fibers of nylon, polyester and acrylic were present in the 1950s. With initial development of nylon resin and polyester

film already completed, Toray began production of these products.

“Tetoron” Polyester Fiber: Following rayon and nylon, Toray planned to develop a third polyester fiber, so from about 1952, it started into serious research and development. After starting production at the Mishima Plant in 1958 using ICI’s technologies, Toray focused on stabilizing production and improving quality while it also started to develop manufacturing methods that would dramatically reduce production processes and costs.

“Toraylon” Acrylic Fiber: After Tetoron, Toray started basic research into acrylic fiber in 1952 as its fourth fiber. After a temporary interruption, it installed a three-ton-per-day test facility at the Nagoya Plant in 1959.

“Amilan” Nylon Resin: Toray’s research and development of plastics for molding applications started with the development in 1954 of cold-resistant, weather-resistant nylon for special procurement electric cable coatings. It went on to develop new product types and grades.

“Lumirror” Polyester Film: Using licensed technologies from ICI, Toray developed manufacturing technologies in 1958 with a focus on biaxial orientation (longitudinal and lateral orientation). It started test production at the Mishima Plant in 1959.

Establishment of R&D Divisions and Business Expansion (1960–1984)

- **Establishing Basic Research Laboratories, and Application Research Center for Fibers and Textiles**

During the 1960s, Toray grew quickly through synthetic fibers. Over the decade through to 1970, companywide net sales grew by more than 12

percent per year on average. With the increasing scale of production and sales, Toray also expanded its R&D structure. It established the new R&D Division in March 1960 (changed later to the Research Division in 1963), and created the Research Department and Development Department. In December 1960, it enhanced its basic research function and established the new Basic Research Laboratories (opened in 1962), within the R&D Division, to enable blue-sky research for the purpose of creating new products for brand new growth lines. At the same time, it established the Technology Research Department, Patent Department, and R&D General Affairs Section (later to become the Research Technology Administration Department).

On the other hand, Toray also transferred its fibers and textiles business-related research laboratories and testing facilities to the Fiber Production Division, while opening Textile Labs, Dyeing Labs, Engineering Labs, Product Labs, and Industrial Materials Labs within the Shiga Plant. It also opened the Application Research Center as a large group of labs researching the application processing of synthetic fibers.

- **Development of a Research Structure and Expansion of Areas of Research**

In 1969, Toray established the R&D Division to coordinate all the research functions spread across various organizations. While following



Completed Basic Research Laboratories (1962)

the policies of expanding its plastics business and strengthening R&D and production of the raw material, Toray established the Petro-chemistry Research Laboratory (1968) and the Development Research Laboratories (a merger of the Central Research Laboratories and the two labs of the Plastics Division) within the R&D Division. It also integrated the fibers and textiles research facilities to establish the new Fibers & Textiles Research Laboratories. It located other labs as well, including the Basic Research Laboratories and the Engineering Research Laboratories, in the R&D Division.

For a while in 1973, control of the three laboratories for fibers and textiles, plastics, and chemicals were returned to their business divisions. But when the whole organization was restructured along functional lines in 1976, all laboratories were brought back together as part of efforts to streamline management. Toray established the SPR (sales, production, and research; predecessor of MPR) System to review and streamline research topics, while also establishing the Technical Information Department and the Analysis Center for physical properties and analysis-related research (spun off as the Toray Research Center in 1978). In 1982, Toray changed direction toward enhancing its research resources in line with the Research Mid-term Project formulated that same year. As a result, it focused particularly on expanding new research areas, and basic and exploratory research.

• **New Business Development**

In January 1970, Toray removed the word Rayon from its name, changing to Toray Industries, Inc. in expectation of the launch of new growth lines as the synthetic fiber market, which had already become a major focus

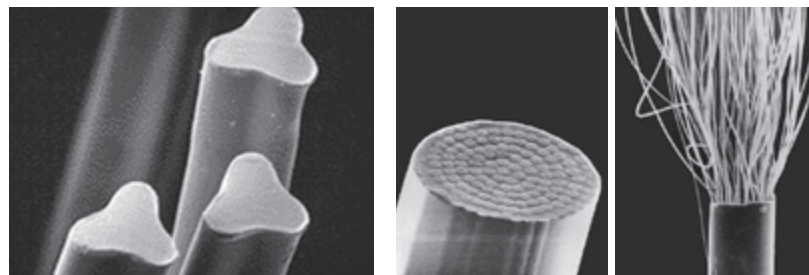
for the company, moved toward maturity in Japan. In 1971, the company established the New Business Promotion Department, reporting directly to the president. As a core organization driving new business development companywide, the new department brought together research and technology development projects together with business planning, sales development and market research functions. In 1974, it became the New Business Division (name changed to Development Business Division in 1976 and then to New Business Divisions in 1979) to evaluate the potential of commercialization projects identified through research and sales development, and to establish new independent organizations for projects after the development stage. Through this process, many new businesses were advanced, including carbon fiber composite materials, prostaglandin derivative drugs, interferon drugs and other pharmaceuticals, artificial kidneys for dialysis, reverse osmosis (RO) membrane modules, and graphic materials.

• **Main R&D Outcomes: 1960–1984**

Fibers and Textiles: Although the synthetic fibers business grew significantly, it was a time of fierce competition with other companies, so Toray was busy developing new products to reduce costs and generate added value. It developed a range of nylon products including bicomponent fiber, modified cross-section filament, non-sizing yarn, anti-static yarn, and ultrafine yarn, and a range of industrial materials and interior products including tire cord filament, and bulked continuous filament (“BCF”) for carpet. Toray applied ideas, from the technologies and value-adding processes developed with nylon, to Tetoron polyester fiber and Toraylon acrylic fiber, and launched

many new products according to the various characteristics and applications of each.

The main examples of those new products are shown in table 8-1. A good example is polyester fiber. In 1964, Toray developed “Sillook,” a highly transparent yarn with a triangular cross section. With woven fabrics made from the yarn having a silky feel and elegant gloss, it became a pillar of the company’s product differentiation.



Sillook cross section

Ecsaine fiber (multiple fibers from a single thread; left)

Table 8-1 Main New Fiber and Textile Products (1960–1984)

	New Products
Nylon	“Tapiion” bicomponent polymer fiber
	“Amick” modified cross-section filament
	Non-sizing yarn (NOS)
	“Parel” anti-static yarn
	“Lupina” thin PTY (producer’s textured yarn)
	“Royalsofy” ultrafine yarn
	Tire cord filament
	Monofilament for fishing nets
	Various bulked continuous filaments (“BCF”) for carpets
“Tetoron”	“Sillook” modified cross-section filament
	Disperse dye, easy-dyeing fibers
	“Tetwel” anti-pilling staple fiber
	“Silgian” modified cross-section staple fiber
	“Sillook II” modified cross-section, modified shrinkage blended fiber
	“Sillook III” modified cross-section, random crimping yarn
	“Sillook IV” modified cross-section, multiple crimping yarn
	FINT non-twist and non-sizing Tetoron yarn
	“Sumola” PBT (polybutylene terephthalate) fiber
	“Severis” antibacterial and deodorant fiber
“Axtar” filament nonwoven fabric	
“Toraylon”	“Toraylon Unfla” flame retardant fiber
Artificial Leather	“Ecsaine” suede-texture artificial leather
Fiber Processed Product	“Entrant” moisture-permeable waterproof textile

Toray also started developing suede-texture artificial leather from 1968. Using a special composite spinning method, it developed an ultra-fine fascicular fiber with a denier of about 0.1. With a three-dimensional intertwined structure, it had the texture and moisture-permeability of natural leather, and a soft touch and suede effect achieved through surface buffing. In 1971, Toray started mass production of the fiber under the trade name “Ecsaine” (now “Ultrasuede”).

Alongside development of these new products, Toray also created several innovative technologies and devices, such as direct spinning and drawing (DSD) equipment, a partially oriented and draw-textured yarn (POY/DTY) process, and a one-step high-speed spinning process (OSP), which contributed enormously to its synthetic fibers business taking a great leap forward.

Resins, Films, and Chemicals: In addition to fibers and textiles, Toray developed many new products, including ABS, PBT, PPS and other new resins and high value-added Lumirror products, which have become the foundation products of their respective business at Toray today. The main examples are shown in table 8-2.

Table 8-2 Main New Products Other Than Fibers and Textiles (1960–1984)

New Fields Other Than Fibers and Textiles		New Products
Plastics and Chemicals	Plastics (Resins)	Nylon 66, nylon 12
		“Toyolac” ABS resin
		“Toraycon” PBT resin
		“Torelina” PPS resin
	Plastics (Films)	“Torayfan” for coatings and electric capacitors
		“Toraypef” polyolefin foam sheet
		“Lumirror” (V37) for home video applications “Lumirror” (V-FAP) high-strength film
Chemicals	L-Lysine essential amino acid	
New Businesses	Carbon Fibers	Polyacrylonitrile (PAN) fiber for carbon fiber
		“Torayca” carbon fiber (T300 grade)
	Medical Products	“Filtrizer” hollow fiber dialyzers
		“Anthon” antithrombogenic material
	Pharmaceuticals	PGF _{2α} ecbolic injectable solution
		“Feron” interferon-β preparation
	Graphic Systems	“Torelief” photosensitive nylon resin relief printing plate
		“Toray Waterless Plate”
	Optical Products	“Breath-O” soft contact lenses
	Water Treatment	“Romembra” high-performance reverse osmosis (RO) membranes
Electronic and Information Materials	IC carrier tape (ICC, KCC)	
	“Semicofine” polyimide (PI) coating material for semiconductors	

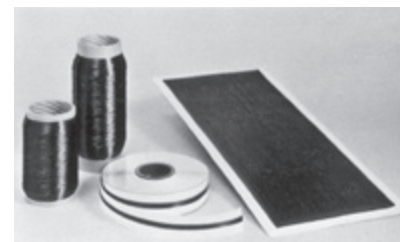
New Businesses: This was the period during which Toray mainly started into businesses other than its current fibers and textiles, resins, films, and chemicals businesses. The company pushed forward all at once into research and technology development of new businesses. The main outcomes are shown in table 8-2, but touching briefly on the development of carbon fibers, Toray’s research and development started in 1961. This was after an academic presentation about polyacrylonitrile (PAN) based carbon fiber given by Dr. Akio Shindo from the Osaka National Research Institute of the Agency of Industrial Science and Technology (now the National Institute of Advanced Industrial Science and Technology (AIST)). Toray found that by using the new compound hydroxyethyl acrylonitrile (HEN), which had been successfully synthesized at the Basic Research Laboratories, as a copolymer component of PAN, it could dramatically improve the performance of the carbon fiber. Establishing the CROW Project across its laboratories in 1969, Toray proceeded to develop a series of fundamental technologies. In addition, it entered an agreement with Union Carbide Corp. to exchange carbonization and precursor technologies, licensed the basic patents of Dr. Shindo, and started production in 1971.



Toyolac molded products (automobile parts)



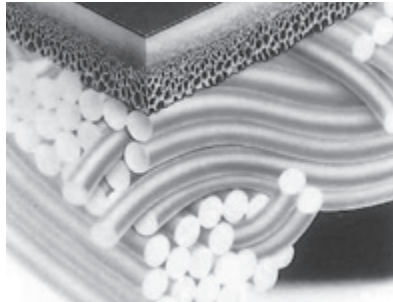
Lumirror film processing (Gifu Plant)



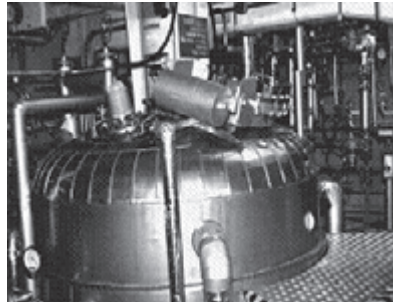
Torayca carbon fiber



Filtrizer dialyzer and patient monitoring device



Romemбра RO membrane structure



Feron culture tank

Establishment of the Technology Center, and R&D in Growth Business Fields (1985–2001)

• Establishment of the Technology Center

In April 1985, Toray established the Technology Center as the headquarters for research and technology development across the whole company.

The Technology Center in the narrow sense consisted of a core Planning Department and the organizations that conducted the actual development. It also had a broader sense though, which was a virtual organization consisting of the R&D Divisions, Engineering Division, Manufacturing Division, and the various technical departments attached to the business divisions. The mission of the broader Technology Center was to maximize



Technology Center (now TC-2)

limited technological resources in order to “Respond to intensifying competition in Japan and overseas and to rapid technological innovation, to secure advantages in current markets, and to develop new markets” and to “Achieve further efficiencies in technology development linked to marketing strategies.” Its basic policies were defined as (1) Reorganize development structures, (2) Strengthen the functions of technical planning staff, (3) Enhance ties with business divisions, and (4) Enhance information functions.

Based on this, the Technology Center established the MPR (manufacturing, production, and research) System to distribute management resources in line with each business strategy. The MPR System is used by executives in the Technology Center and business leaders to coordinate business strategies with R&D policies, and to determine projects and resources for research and technology development each fiscal year. To prioritize and accelerate R&D, the Technology Center also developed various systems including a specific urgent issue system, a priority development issue system, a priority field system, and a subsidiary/affiliated company support system.

When allocating expenses for R&D projects, Toray created a Divisional Research (DR) category of business research where the business divisions bear the cost, and a Corporate Research (CR) category where head office bears the cost. It also added a CR-II category. At this time, the previous CR category was renamed CR-I and related to projects set at the discretion and responsibility of the R&D Divisions, with approvals granted by the Technology Committee. On the other hand, the CR-II category related to head office expenses allocated to development projects at the responsibility of the General Manager of the Technology

Center. This new system played an important role in new business development, cross-industry development, and development at subsidiaries and affiliated companies. These roles, expectations and whole series of measures of the Technology Center have continued and have become the backbone of the current Technology Center operation system.

- **Separation of Research and Development**

In 1987, Toray separated the development function from the R&D Divisions. This separation of research and development marked the start of an important change for the development organization. Research was defined as aiming to create new materials and new functions with competitive advantages, and establish fundamental technologies based on creative ideas regardless of past performance or deadlines. Development, on the other hand, to commercialize the materials and functions created through research, and then developed technologies with a sense of urgency under quality, cost, development lead-times and other restrictions.

In August 1987, R&D Divisions' Development Department function and projects were transferred to the Technology Center as development promotion groups. At the same time, the roles of the Technical Center and the Manufacturing Division's technical departments were clarified, with the Technical Center in charge of technology development in new business fields, and the Manufacturing Division's technical departments in charge of technology development in existing business fields. In June 1991, a New Projects Development Division was established at the Technology Center, thereby completing the process of separating research and development functions.

- **Research System Responds to Business Diversification and Pursues Cutting-edge Technologies**

Around this time, Toray restructured and enhanced its research laboratories, and established independent research laboratories for each area of research. It reorganized or newly established the Polymer Research Laboratories and Electronic and Imaging Materials Research Laboratories in 1987, the Plastics Research Laboratories (Nagoya) and Composite Materials Research Laboratories (Ehime) in 1990, the Chemicals Research Laboratories in 1991, and the Medical Devices and Diagnostics Research Laboratories in 1992.

In 1999, it established the new Basic Research Laboratories (Kamakura) as a division-level organization, and below that established the Pharmaceutical Research Laboratories (name changed from the previous Basic Research Laboratories) and the Advanced Research Laboratories (through a merger between the Polymer Research Laboratories and Medical Devices and Diagnostics Research Laboratories). The Advanced Research Laboratories focused primarily on researching new medical, environmental and functional materials that offered promise for the 21st century. It aimed to research cutting-edge technologies and state of the art technologies covering many business fields.

- **Expansion and Promotion of Development Projects at the Technology Center**

When it was first established, the Technology Center focused on five development projects: (1) "Furtasti" artificial fur, (2) Optical fiber, (3) Ceramics, (4) Medical products, and (5) Toner. By 1990 though, it had

established five new development promotion groups or projects: (6) LCD materials (LCM), (7) Polyacetal resin (RAP), (8) High-speed printers (TNP), (9) Large-scale composite material structures (LSS), and (10) Composites. In June 1991, these groups and projects were incorporated into the New Business Development Division at the Technology Center. From that point, the division added other projects including “Torayrom” water purifying systems, optical disks, STP (Samsung-Toray project for forming and mounting flexible circuits on semiconductors), and plasma display panel (PDP) materials. With the majority of these projects becoming commercialized by business divisions and subsidiaries/affiliates, the Technology Center proved its worth as an incubation center for development projects.

- **Advancement System: From Research to Development, From Development to Production**

Toray separated its functions of research and development, but at the same time developed a system of advancing projects from research to development, and from development to production. Projects needed to be quickly advanced, but at the most appropriate time, because moving projects forward to the next stage too easily posed serious risks, while moving them forward too cautiously would result in lagging behind the competition. For this reason, in 1988, Toray formulated the R&D Advancement System for determining appropriate timing for advancing projects through stages, from research to development or from development to production. This system enabled a more efficient transition from research to development. A new Stage Gate System was then adopted in 1999 to enable more objective judgments for advancing research

according to *gate criteria*. This new system worked to improve the success rate and increase the speed of development projects.

- **Other R&D Measures**

Toray had emphasized the importance of patents for a while, establishing a dedicated Patent Department, but in 1991, it also established the Intellectual Property Department and developed a more comprehensive system of managing and utilizing IP rights, including patents, utility models, trade names, designs, and computer program copyrights. Continuing these activities, the department was separated and is now named the Intellectual Property Division. Toray then launched a program of measures designed to develop and stimulate its HR involved in research and technology development. These measures included establishment in 1988 of the Fundamental Technologies Conference, covering polymerization, spinning, fibers application processing, film formation, and organic synthesis and other technologies, to further deepen and expand the fundamental technologies that are the technology foundations of Toray. They also included establishment in 1992 of the Research Fellow System to develop a culture where researchers were able to devote themselves to extended research and improve through friendly rivalry, and establishment in 1997 of an award system specifically for the R&D Divisions and Technology Center.

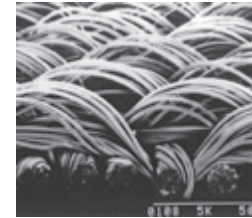
- **Main R&D Outcomes: 1985–2001**

During this period, Toray commercialized a series of *Shin-gosen* (new types of synthetic fiber) products. At the same time, it broadened its R&D areas in pursuit of many new cutting-edge and state of the art

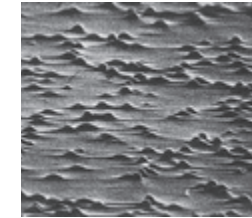
technologies that would become growth business fields for the 21st century. As explained above, it also spun off many development projects, incubated in the Technology Center, as independent divisions.

Table 8-3 Main New Products (1985–2001)

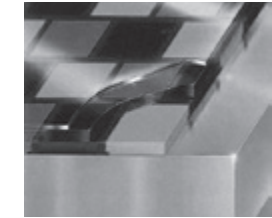
Business Fields	New Products
Fibers and Textiles	“Sillook Sildew” multistage, modified shrinkage blended yarn & textile
	“Sanoi” new filament/staple fiber composite spun yarn
	Nylon for air bags
	“Makspec” non-formalin antibacterial material
Resins and Chemicals	“Intercat” interferon for cats
	“Siveras” liquid crystal polyester (LCP) resin
Films	“Torelina” polyphenylene sulfide (PPS) film
	“Mictron” aramid film
	“Lumirror” products using new surface-forming technologies (TOP-PTL)
	“Lumirror” reflective film for LCD backlight units
IT-related Products	“Photoneece” polyimide (PI) coating material for semiconductors
	Manufacturing technologies and pastes for forming plasma display panel (PDP) rear substrates
	“Toptical” color filters
Housing and Engineering	“Torayvino” home water purifiers
	“Romembra” two-stage reverse osmosis membrane for production of ultra-pure water
Pharmaceuticals and Medical Products	“Dorner” treatment agent for peripheral vascular disease
	“Toraymyxin” blood purifier for removing endotoxin
	“Toraysulfone” polysulfone membrane artificial kidneys
New Businesses	“Toraysee” high-performance wiping cloth
	“Torayca” carbon fiber composite material for use as primary structural material in aircraft
	Fuel cell electrode material
	“Torayca” composites for use as automobile material



Sillook Sildew fabric cross section



Lumirror product using new surface-forming technologies (TOP-PTL)



Toptical color filters

From New Toray Reforms to Green Innovation and Life Innovation (2002–2017)

• Departure from Fiercely Independent R&D (Technology Integration and Internal/External Collaboration)

During the fiscal period ending March 31, 2002, Toray faced extremely difficult conditions, with non-consolidated operating income falling into the red for the first time since the company was founded. In April 2002, Toray launched the New TORAY₂₁ (NT₂₁) mid-term management program designed to reform every area of the company, from its management systems to codes of behavior. As part of the NT reform, the company began its departure from “fiercely independent R&D” approach to research and technology development.

Looking at Toray’s business relationships, including nylon with DuPont, carbon fiber with Union Carbide, and with Boeing and UNIQLO, there are many examples from the beginning of Toray coupling its own technologies with the technologies and know-how of other companies to create new value and grow as a company. Toray took the bold decision to deliberately move away from its “fiercely independent

R&D” approach because it saw a need to implement research and development initiatives using more than just its own product ideas. With an actively outward-looking stance, it would be able to achieve its research and development goals, which had recently become more diverse and sophisticated, with a greater sense of urgency. As a result, Toray was able to participate in more than 40 government-approved projects in fiscal 2016 compared to the 10 projects it participated in fiscal 2001, immediately prior to the change. Also in 2016, it collaborated on more than 300 joint research and development projects with general research institutes and leading companies.



New Frontiers Research Laboratories

Coinciding with this change of strategic direction for the company, in 2002, Toray separated the Specialty Materials Research Laboratories, which was working on polymer research in life sciences, IT, and other areas, from the Pioneering Research Laboratories. At the same time, it established the new Global Environment Research Laboratories, which had initially started as in 1991. Then in 2003, Toray opened the open laboratory-linked New Frontiers Research Laboratories to focus on fields such as biotechnology and nanotechnology.

• R&D of Advanced Materials

From October 2006, Toray adopted the basic strategy of expanding advanced materials as part of the Project Innovation TORAY 2010 (IT-2010) mid-term management program it developed under the

“Innovation by Chemistry” corporate slogan. Based on this, the company established two research and technology development strategies: (1) Pursue the outer limits of the Toray Group’s core technologies of organic synthetic chemistry, polymer chemistry, biotechnology and nanotechnology, and create advanced materials through integration of these technologies, and (2) Allocate approximately 80 percent of companywide development resources to advanced materials in order to accelerate innovation. It established display innovation materials, automobile and aircraft innovation materials, pharmaceuticals and life sciences, and environment- and energy-related materials as the most important fields for advanced material development. It also established process innovation, advanced nanotechnologies, basic materials and advanced molecular design, and biotechnology innovation as technologies for strategic enhancement. From a range of individual development projects, Toray selected its APEX 40 list of 40 projects that would offer the greatest impact when commercialized. From among those challenges, it also selected an APEX Challenge list of priority development projects with a particularly high level of difficulty.

In 2010, Toray established the new Advanced Materials Research Laboratories, within the Basic Research Center (name changed from Basic Research Laboratories), to enhance the Specialty Materials Research Laboratories function. In 2009, Toray also established the Automotive & Aircraft Center (A&A Center) within the Technology Center as the company’s site for technology development in the automobile and aircraft field. Within that A&A Center, it located the Automotive Center, Advanced Composites Center, and Plastics Application Technology & Development Center.

As an 80th anniversary project, Toray held the Toray Advanced Materials Symposium and Toray Advanced Materials Exhibition in 2006 to introduce Toray's advanced materials to the broader community. The Symposium included seminars by four world-renowned speakers. These events were also held in fiscal 2011 and fiscal 2016.

- **Green Innovation and Life Innovation Initiatives**

Toray launched the Action Program for Growth (Project AP-G) as a mid-term management program in April 2011. As part of its Project AP-G 2013, it established business expansion in growth business fields as one of its basic strategies. While maintaining its basic approach to research and development in areas such as open innovation, deepening core technologies and technology integration as previously discussed, this marked a shift to Green Innovation for Toray's important areas of research and development. Positioning its solutions businesses for global environmental issues and resource energy issues as Green Innovation businesses, Toray prioritized efficiency improvement for energy usage, new energy and non-fossil resource utilization, and seawater desalination and wastewater purification, as Green Innovation-related projects.

As part of Project AP-G 2016, launched in 2014, Toray added Life Innovation to its basic strategies as priority fields for research and development, and positioned improvement of the quality of healthcare, easing the burden on medical institutions, and contributing to health and longevity, as Life Innovation businesses. Following this program, Toray allocated 50 percent of its research and technology development budget to Green Innovation and 20 percent to Life Innovation, creating innovative

new materials and technologies as a result. The same strategies were retained in Project AP-G 2019, launched in 2017.

In April 2016, as a 90th anniversary project, Toray made the decision to establish the R&D Innovation Center for the Future as a new research site at the Shiga Plant. (Construction is expected to be completed in December 2019.) It hopes to promote and enhance future-creation R&D—for *kotozukuri* (solution development) that utilize the strengths of materials—and life-enrichment R&D, in search of functions and systems required by the society of the future.



R&D Innovation Center for the Future
(artist's impression)

- **Implementation and Acceleration of New Product and Technology Development**

Alongside these R&D initiatives, the Technology Center also worked on accelerating the pace of development. In 2003, the Center brought together the functions of research, technology development, production and marketing, and established what it called the Jet Coaster Program, an awareness initiative to quickly tackle development issues from the customer's perspective. It also established a system for appropriate promotion of development themes in various categories: (1) Business expansion projects able to be developed into core businesses within two to three years, (2) Commercialization promotion projects able to become commercialized within two years, and (3) Commercialization potential

projects for quickly developing commercialization scenarios. In 2009, the Center also created an Ar-DASH category, for projects able to produce results within one year, for the purpose of concentrating resources and accelerating technology development.

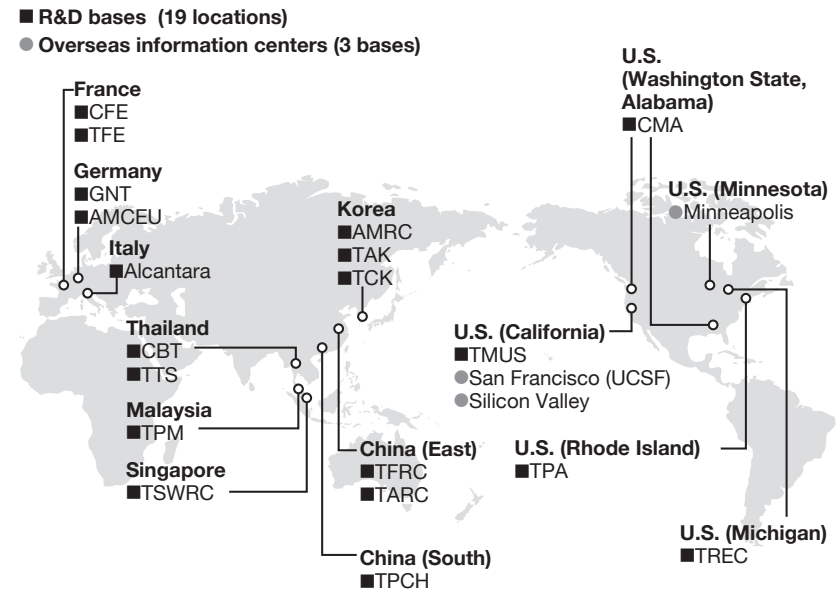
It also introduced pipeline management to continually generate promising projects by also preparing the next project related to the one in development, and the next one after that, at the same time. And it planned and invested in efficient development strategies from the mid-to long-term perspective.

• **Establishment and Expansion of Global R&D Bases**

Together with its business globalization, Toray actively promoted the globalization of its R&D bases. It focused on utilizing top researchers in each country and generating new ideas through an interdisciplinary/cross-cultural integration, while promoting joint R&D activities with local leading customers, universities, and research institutes. In China, where the fiber and textile industry was experiencing particularly strong growth, Toray established Toray Fibers & Textiles Research Laboratories (China) Co., Ltd. (TFRC) in 2002 as an R&D base for all polymer science, fiber and textile technologies. In 2004, it opened a Shanghai branch to develop advanced polymer materials. The branch became Toray Advanced Materials Research Laboratories (China) Co., Ltd. (TARC) in 2012. It also established the Carbon Fiber Composite Materials Technical Center in the U.S. in 2007, Advanced Materials Research Center (AMRC) in Korea in 2008, to develop advanced materials, and Toray Singapore Water Research Center (TSWRC) in 2009 to conduct water treatment research. As shown in table 8-4, Toray currently

has a global research and technology development network covering 19 locations in nine countries, with information centers in three locations.

Table 8-4 Global R&D Bases (as of October 2017)



TFRC (China)

• **Main R&D Outcomes: 2002–2016**

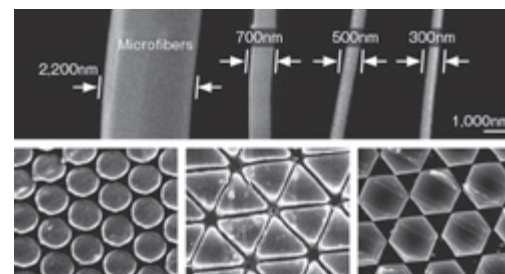
As shown in table 8-5, outcomes of this period often concerned nano-technologies, biotechnologies and research technology integration.

Table 8-5 Main New Products (2002–2016)

Business Fields	New Products
Fibers and Textiles	3GT stretch bicomponent fiber
	‘Heattech’ heat-generating and heat-retaining innerwear ^{(*)1}
	Products using innovative nanofiber technologies
Resins and Chemicals	Self-organizing “Nanoalloy” products
	Chemical-resistant ABS/ polycarbonate (PC) resins
	“Ecodear” polylactic acid (resins, films, fibers)
Films	Biaxially-oriented “Nanoalloy” film
	“Picasus” ultra-thin multi-layer laminate film
Electronic and Information Materials and Devices	Organic electroluminescent (EL) red emitting materials and electron transport materials
	Polyimide (PI) coating materials for organic EL displays
	“Raybrid” photosensitive functional material for touch panels
Carbon Fiber Composite Materials	Products using ultra-high-speed press technologies
	High-cycle carbon fiber reinforced plastic (CFRP) for automobiles
	“Torayca” T1100G high-strength, high-modulus carbon fiber
Environment and Engineering	“Membray” submerged flat sheet membrane module for MBR
	“Torayfil” ultra-filtration (UF) membrane for wastewater reuse
Pharmaceuticals and Medical Products	“3D-Gene” DNA chips
	‘Remitch’ oral antipruritus drug ^{(*)2}
	“Toraylight” NV dialysis membrane for inhibiting platelet adhesion

*1. ‘Heattech’ is a registered trademark of Fast Retailing Co., Ltd.

*2. ‘Remitch’ is a registered trademark of Torii Pharmaceutical Co., Ltd.



World’s first modified cross-section nanofibers



Picasus nano meter-scale multi-layered laminate film



3D-Gene high-sensitivity DNA chips

• **Creating Further Advanced Materials**

It takes a certain amount of time to develop and commercialize new materials. It is therefore vital to have insight into the value of materials, and to work persistently with a *super-continuity* approach. For example, Toray started researching carbon fibers in earnest in 1961, and started test production in 1971. It always hoped to extend the fiber to aircraft someday, but there was no carbon fiber market at the time. It developed markets for applications such as fishing rods and golf clubs, and kept refining its technologies while maintaining production. Eventually, Toray’s carbon fiber composite materials were used as material for aircraft. Usage grew from secondary structural material to primary structural material as applications expanded, and it now accounts for more than half of

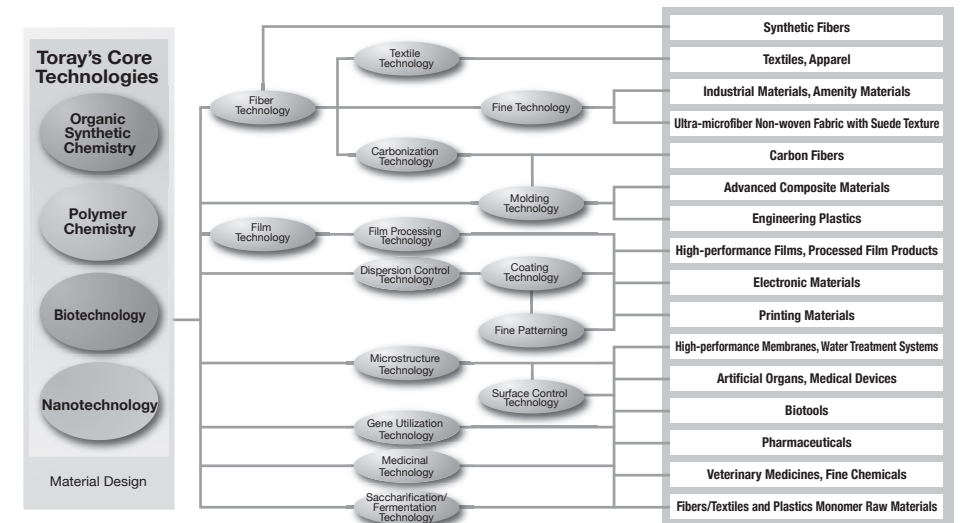
the structural materials used on Boeing 787s (a massive 35 tons approximately per aircraft). Commercial operation of 787s started in 2011, and with more than 1,200 confirmed orders for the aircraft as of June 2017 (according to the Japan Aircraft Development Corporation), the material is now flying around the world on a daily basis. The carbon fiber journey, from research and development to this point, has resulted in the creation of an enormous new business thanks to what was truly a massive investment in the future.



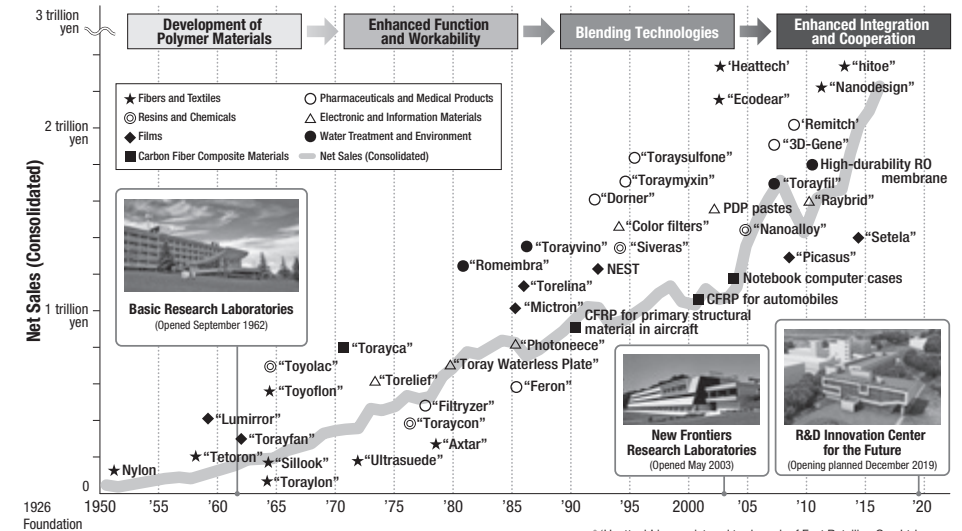
Boeing 787
©The Boeing Company (Photo courtesy of ANA)

Advanced materials, such as “Romembra” reverse osmosis (RO) membranes for water treatment and “Mictron” aramid film, are also the result of working persistently with this *super-continuity* approach. Inventions and discoveries that lead to major businesses do not occur every year. The fact is that it takes a while to commercialize products, so for Toray to continue expanding, it is essential that the seeds of major new businesses are continually planted. Toray believes that without material innovation, it would be unable to deliver essential solutions and attractive new products. Going forward, it will continue to create advanced materials through forward-looking research and technology development according to the needs of the times, and continue to tell the world about these advanced materials.

Toray Technologies for Creating New Functions and Quality



History of Toray's Progress and Product Development



* 'Heattech' is a registered trademark of Fast Retailing Co., Ltd.
* 'Remitch' is a registered trademark of Torii Pharmaceutical Co., Ltd.

Chronology

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
1925	Sept.	Resolution on establishment of a rayon manufacturing company approved at Mitsui & Co.'s board of directors meeting
1926	Jan.	Inaugural general meeting of Toyo Rayon Co., Ltd. (Toray); Yunosuke Yasukawa appointed chairman
	Aug.	First general meeting of shareholders
1927	Apr.	Shiga Plant completed; production of rayon yarn began in August
	Nov.	Sales of rayon yarn began with Mitsui & Co. as general agent
1929	Oct.	• <i>Great Depression began</i>
1934	July	Listed on (pre-war) Tokyo and Osaka stock exchanges
1935	July	Production of rayon staple fiber began at Shiga Plant
1937	Dec.	Senior managing director Asahiko Karashima appointed chairman
1938	Feb.	Seta Plant completed (sold in 1941, re-acquired in 1951)
	Apr.	Ehime Plant of Toyo Kenshoku Company completed
1939	Sept.	• <i>World War II began</i>
	Dec.	Melt spinning of nylon 66 fiber succeeded
1941	May	Polymerization and melt spinning of nylon 6 fiber succeeded
	July	Absorption-type merger with Toyo Kenshoku (now Ehime Plant), Shonaigawa Rayon Company, and K.K. Shonaigawa Dye Works (now Aichi Plant)
	Dec.	• <i>Pacific War began</i>

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
1942	Oct.	Chairman Asahiko Karashima stepped down; Director Yosaburo Ito appointed chairman
	Oct.	“Amilan” chosen as trademark for nylon products
	Dec.	“Amilan” fishing line launched
1944	May	Chairman Yosaburo Ito appointed president
1945	Sept.	• <i>Japan accepted the Potsdam Declaration and signed the Japanese Instrument of Surrender; World War II (Pacific War) ended</i>
	Nov.	Managing director Shigeki Tashiro appointed president
1947	June	President Shigeki Tashiro purged from public office and resigned
1948	July	Managing director Kikuo Sodeyama appointed president
1949	Feb.	Production of nylon yarn began at Shiga Plant
	May	Listed on Tokyo, Osaka, and Nagoya stock exchanges
1950	Mar.	Shigeki Tashiro appointed chairman
	June	• <i>Korean War began (armistice agreement signed in July 1953)</i>
1951	Feb.	Production of nylon yarn began at Aichi Plant
	Apr.	Production of caprolactam began at Nagoya Plant
	June	Agreement on nylon technology licensing concluded with E. I. DuPont de Nemours & Co. (U.S.)
1952	Aug.	Sales of nylon stockings began
1953	Mar.	Sales of “Amilan” nylon resin began
	Apr.	Comprehensive budget system formulated
1954	Nov.	Deming Prize received
1955	Mar.	Company Principles formulated
	July	Trilon Co., Ltd. established in Hong Kong
1956	Apr.	Opening ceremony for Central Research Laboratories

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
1957	Feb.	Toray and Teijin signed a technological alliance agreement related to polyester with Imperial Chemical Industries Ltd. (ICI) (U.K.)
	July	Representative dispatched to New York City
	Aug.	Representatives dispatched to Hamburg, Bangkok, and Beirut
1958	Jan.	• <i>European Economic Community (EEC) launched with six member countries</i>
	Mar.	Mishima Plant completed; production of “Toray Tetoron” polyester fiber began
1959	Oct.	Production of polyester film (named “Lumirror” in 1960) began
1960	Mar.	Okazaki Plant completed
	Mar.	Managing director Hirosaburo Mori appointed president
	June	Authorization for the establishment of Toyo Rayon Science Foundation (now Toray Science Foundation) received
	Sept. Dec.	• <i>Organization of the Petroleum Exporting Countries (OPEC) launched</i> Sublicensing agreement on polypropylene fiber manufacturing technology of Montecatini Chemical & Mining Company (Italy) signed with Mitsui Chemical Industry Co., Ltd.
1961	Sept.	• <i>Organisation for Economic Cooperation and Development (OECD) launched</i>
1962	Mar.	Production of caprolactam by PNC method began at Nagoya Plant
	Sept.	Opening ceremony of Basic Research Laboratories
	Dec.	Modified cross-section polyester filament developed
1963	Mar.	Thai Toray Textile Mills Co., Ltd. (TTTM) established in Thailand
	May	Rayon filament yarn production wound down at Shiga Plant
	June	Production of “Torayfan” polypropylene film began at Shiga Plant
	Oct.	Sales of elastic polyurethane fiber began (transferred to Toyo Products Co., Ltd. in October 1964)

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
1964	Feb.	Production of “Toyolac” ABS resin began at Nagoya Plant
	Mar.	Production of “Toraylon” acrylic staple fiber began at Ehime Plant
	Apr.	• <i>Japan accepted IMF Article VIII</i>
	May	15 million dollar convertible bonds issued in London and listed on London and Luxembourg stock exchanges
-	-	Disclosure of consolidated financial settlement from the first half of fiscal 1964 started (SEC standard / adopted Japanese standard from fiscal 1984)
	1965	Apr. June
1966	Nov.	President Hirosaburo Mori stepped down; Executive vice president Seiichiro Hirota appointed president
1967	July	• <i>European Communities (EC) launched with six member countries</i>
	Aug.	• <i>Association of Southeast Asian Nations (ASEAN) launched with five member countries</i>
1968	Mar.	Trial production of polyacrylonitrile (PAN)-based carbon fiber succeeded
1969	May	Carbon fiber development project (CROW) established
	July	• <i>Apollo 11 successfully landed on the moon</i>
	Oct.	Kawasaki Plant completed (began operation of CPX)
1970	Jan.	Company name changed to Toray Industries, Inc.
	Apr.	American Depositary Receipt (ADR) of Toray Industries issued in the U.S.
	Apr.	Cross-license agreement on carbon fiber manufacturing technology signed with Union Carbide Corporation (UCC) in the U.S.
	July	Chiba Plant completed and production of “Toyolac” began
	Oct.	Tsuchiura Plant completed and production of “Torayfan” began
	Nov.	Chairman Shigeki Tashiro appointed honorary chairman
	Dec.	• <i>Clean Air Act (Muskie Act) enacted in the U.S.</i>

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
1971	Feb.	Tokai Plant completed and production of caprolactam and terephthalic acid began the following March
	June	• <i>Okinawa Reversion Agreement signed</i>
	July	Gifu Plant completed and production of “Lumirror” began
	Aug.	Pilot production for “Torayca” carbon fiber completed at Shiga Plant
	Aug.	• <i>The U.S. announced emergency measures to stabilize the dollar (Nixon shock)</i>
	Oct.	• <i>Japan and the U.S. signed an agreement to restrain textile exports to the U.S.</i>
	Nov.	President Seiichiro Hirota stepped down and executive vice president Kizo Yasui appointed chairman; Executive vice president Tsuguhide Fujiyoshi appointed president
	Dec.	• <i>Shifted to Smithsonian Agreement on currency realignment negotiated between the G-10</i>
1972	Jan.	Export of caprolactam started
	Mar.	Exclusive distribution rights agreed on for ‘Kapton’ polyimide film in Japan with DuPont
	Aug.	Four million stocks issued at market price in Hong Kong and listed on Hong Kong Stock Exchange
	Sept.	• <i>Japan-China Joint Communique signed and diplomatic relations established</i>
1973	Mar.	Full-scale production of “Torayca” carbon fiber began at Ehime Plant
	Aug.	Basic Policy for Increasing Green Areas formulated and greening activities started at plants
	Oct.	• <i>1973 Oil Crisis in the aftermath of the Yom Kippur War</i>
	Dec.	• <i>Multifiber Agreement (MFA) established under GATT</i>
1974	Apr.	Iganto S.p.A established as a joint venture in Italy (name changed to Alcantara S.p.A in 1981 and management rights acquired in 1995)
	Oct.	Listed on Frankfurt and Düsseldorf stock exchanges
1975	May	Production of rayon staple fiber wound down at Ehime Plant
	June	Ishikawa Plant completed and production of “Tetoron” filament began

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
1976	Nov.	Began production of polybutylene terephthalate (PBT) resin at Ehime Plant
1977	Aug.	Received a permit to manufacture Prostaglandins “DINOPRON” F (PGF _{2α}) (labor induction agent)
	Sept.	Received a permit to manufacture “Filtrzyzer” PMMA membrane for dialysis (artificial kidneys)
1979	Jan.	• <i>1979 Oil Crisis due to decreased oil output in the wake of the Iranian Revolution</i>
	May	Production of “Toray Waterless Plate” offset printing plate began at Okazaki Plant
	May	Sales of “Entrant” moisture-permeable waterproof woven nylon fabric began
	Nov.	Company organization changed from a function-based to a business division system
1980	Apr.	Sales of “Romembra” reverse osmosis (RO) membrane began
	June	President Tsuguhide Fujiyoshi appointed chairman and executive vice president Masao Ikawa appointed president
1981	Jan.	President Masao Ikawa stepped down and executive vice president Yoshikazu Ito appointed president
	Mar.	“Torayca” prepreg approved under Boeing 767 material standards
	Aug.	Sales of “Breath-O” soft high-water content contact lenses for use after cataract surgery started
1982	Apr.	Mid-term business plan system (three year, rolling system) formulated
	May	First Companywide Safety Conference
	Nov.	Listed on Paris Stock Exchange
	Nov.	First General Marketing and Development Report Meeting
	Dec.	Société des Fibres de Carbone S.A (SOFICAR) established as a joint venture (management rights acquired in 1988 and name changed to Toray Carbon Fibers Europe S.A. (CFE) in 2012)

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
1983	Aug.	Kawasaki Plant (CPX business) and Nippon Petrochemicals Co., Ltd.'s BTX business integrated to establish Ukishima Aroma Co., Ltd. as a joint venture (withdrawn in June 1987)
	Nov.	“Technorama” artificial weather simulation laboratory completed at Seta Plant
	-	Boeing 757, 767, and Airbus A310 using “Torayca” composite materials began service
1984	Dec.	First Toray Pan Pacific Open Tennis Tournament (developed as the successor to Toray “Sillook” tournament)
	Dec.	Sales of polyphenylene sulfide (PPS) resin began
1985	Apr.	Permit to manufacture “Feron” natural high-purity interferon β agent for malignant melanoma and glioblastoma received
	Apr.	Technology Center established
	May	Trea Industries Inc. (U.S.) acquired (name changed to Toray Plastics (America) Inc. (TPA) in February 1989)
1986	Jan.	Sales of polyphenylene sulfide (PPS) film began
	Apr.	Corporate Philosophy, Management Policy, and Toray Motto formulated
	Apr.	New corporate symbol TORAY created
	Apr.	Production of “Torayvino” home water purifier began at Shiga Plant (sales started in July)
	June	Production of nylon filament yarn wound down at Shiga Plant and transferred to Ishikawa and Aichi plants
	Dec.	Toray International, Inc. established
	-	• <i>Japan's total textile import value exceeded total export value in dollar (in yen, exceeded since 1987). Subsequently, trade deficit increased each year</i>
1987	Apr.	Sales of “Toraysee” high-performance cleaning cloth began
	Apr.	President Yoshikazu Ito became chairman and managing director Katsunosuke Maeda appointed president & CEO
	Oct.	• <i>Dow Jones Industrial Average plunged 22.6 % in one week on the New York Stock Exchange (Black Monday)</i>

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
1988	May	Booklet entitled <i>Five Key Points in Innovation in Attitudes and Practices</i> distributed to all managers and specialists
	Oct.	Manufacturing permit for “Inoue-Balloon” catheter for valvular disease treatment received
1989	Jan.	• <i>Montreal Protocol enacted (gradual abolition of designated ozone-depleting CFCs)</i>
	Mar.	Toray Textiles Europe Ltd. (TTEL) established in the U.K.
	Apr.	• <i>3% consumption tax introduced in Japan (raised to 5% in 1997, 8% in 2014)</i>
1990	Apr.	“Torayca” prepreg approved under Boeing 777 material standards, the first carbon fiber material certified for primary structural components of aircraft
	July	Toray Plastics (Malaysia) Sdn. Berhad (TPM) established
	Aug.	• <i>Gulf War began (ceasefire agreement signed in March 1991). Tight demand for crude oil and petroleum products</i>
	Oct.	Production of “Torayca” prepreg began at Ehime Plant
	Oct.	• <i>Re-unification of West and East Germany</i>
1991	Mar.	• <i>Collapse of Japan's asset-bubble economy which began in December 1987</i>
	Apr.	AP-G2000 long-term corporate vision formulated
	Dec.	Toray School of Management opened
	Dec.	• <i>Collapse of the Soviet Union</i>
1992	Jan.	Manufacturing permit for “Dorner” for treatment of chronic occlusive vascular disease received
	Apr.	Identity 2000 (ID-2000) campaign launched (until March 31, 1995)
	May	Toray Composites (America), Inc. (TCA) established in the U.S.
	June	Research Fellow System formulated

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
1993	July	Malaysia Toray Science Foundation (MTSF) established (foundations established in Indonesia in December 1993 and in Thailand June 1994)
	Oct.	Manufacturing permit for “Toraymyxin” blood purifier for sepsis treatment received
	Oct.	Production of color filter for liquid-crystal displays (LCD) began at Seta Plant
	Nov. Dec.	• <i>European Union (EU) launched</i> Production of “Intercat” animal drug began at Ehime Plant
1994	Jan.	• <i>North American Free Trade Agreement (NAFTA) enacted</i>
	June	Outside corporate auditor appointed for the first time
	Aug.	Toray Sakai Printing & Dyeing (Nantong) Co., Ltd. (TSD) established in China jointly with Japanese company
	Oct.	Use of designated CFCs in production processes completely abolished
1995	Jan.	• <i>World Trade Organization (WTO) launched</i>
	Jan.	• <i>Great Hanshin-Awaji Earthquake (magnitude 7.3)</i>
	Apr.	Management Philosophy Framework comprising Corporate Philosophy, Corporate Missions, and Guiding Principles formulated
	May	Toray Fibers (Nantong) Co., Ltd. (TFNL) established in China
	May	Boeing 777 passenger aircraft using “Torayca” composite material began service
1996	Jan.	Toray’s website launched
	Mar.	Toray Human Resources Development Center opened in Mishima City, Shizuoka Prefecture
	Apr.	• <i>First Asia Chemical Fiber Industries Federation Conference</i>
	Sept.	Toray European Labor-Management Conference established
	Sept.	• <i>ISO 14000 international environmental management and audit standards enacted</i>
	Oct.	Toray Group Senior Management Seminar (TGSMS) opened, targeting local general managers of overseas subsidiaries and affiliates

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>	
1997	Apr.	New AP-G2000 long-term corporate vision launched	
	May	Toray Carbon Fibers America, Inc. (CFA) established in the U.S.	
	June	President Katsunosuke Maeda became chairman and senior managing director Katsuhiko Hirai appointed president & CEO	
	July	• <i>Sovereignty over Hong Kong transferred from the U.K. to China</i>	
	July	• <i>Asia Financial Crisis</i>	
	Aug.	Corporate Ethics Committee established, chaired by the president	
	Nov.	Sponsorship of Shanghai International Marathon began	
	Nov.	• <i>Dow Jones Industrial Average record plunge at New York Stock Exchange</i>	
	1998	Apr.	MT Campaign launched to encourage independent thinking and prompt action
		Sept.	President Katsuhiko Hirai communicated a message about thorough implementation of corporate ethics
	1999	Jan.	• <i>Single currency (euro) introduced to 11 member states of the European Union (EU) (entered circulation in January 2002)</i>
Oct.		Toray Saehan Inc. (TSI) established as a joint venture with Saehan Industries Inc. in Korea (became wholly-owned subsidiary in January 2008 and changed its name to Toray Advanced Materials Korea Inc. (TAK) in May 2010)	
2000	Jan.	Ten Basic Environmental Rules formulated	
2001	July	Yihua Toray Polyester Film Co., Ltd. (YTP) established as a joint venture with Yihua Group Co. in China	
	Sept.	• <i>September 11 terror attacks on the U.S.</i>	
2002	Mar.	Toray Fibers & Textile Research Laboratories (China) Co., Ltd. (TRFC) established	
	Apr.	AP-New TORAY 21 long-term corporate vision launched	
	Apr.	Project New TORAY 21 (NT21) mid-term management program launched	
	Apr.	Shifted to regional supervisory organization system and separate headquarters established in three ASEAN countries and China that year	
	Apr.	Chairman Katsunosuke Maeda reappointed CEO	

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
2002	June	President Katsuhiko Hirai appointed vice chairman and executive vice president Sadayuki Sakakibara became president and COO
	July	First Asian International Conference held in Hong Kong and first International Conference for U.S. and Europe Affiliates held in London in October (integrated with Asian International Conference in July 2009)
2003	Aug.	Quarterly disclosure of financial results from fiscal year ended March 2004 started
2004	Mar.	Toray BASF PBT Resin Sdn. Berhad (TBPR) established in Malaysia as a joint venture with BASF SE of Germany
	Apr.	Project NT-II mid-term management program launched
	May	Long-term supply agreement signed for “Torayca” composite materials for Boeing 787 with the Boeing Company
	June	Chairman Katsunosuke Maeda became honorary chairman and president Sadayuki Sakakibara appointed CEO & COO
	Aug. Dec.	Toray Global Executive Seminar (TGES) established CSR Guidelines formulated
2005	Jan.	• <i>WTO Agreement on Textiles and Clothing expired, and textile trade fully liberalized for the first time in 43 years</i>
	Sept.	Toray Group CSR Report issued
2006	Apr.	Corporate slogan “Innovation by Chemistry” formulated
	Apr.	Management Philosophy Framework revised
	Apr.	AP-Innovation TORAY 21 long-term corporate vision launched
	June	Announced strategic partnership with UNIQLO Co., Ltd.
	July	Toray Group School of Management opened
	Sept. Oct.	Toray Advanced Materials Symposium and Toray Advanced Materials Exhibition Project Innovation TORAY 2010 (IT-2010) mid-term management program launched

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
2007	Jan.	• <i>First Textile & Apparel Quad Meeting held in Tokyo inviting textile industry leaders from Japan, the U.S., Europe, and China</i>
	June	Executive vice president Akikazu Shimomura appointed chairman
	Oct.	Campaign badges (now the corporate badge) distributed to enhance Toray brand
	Nov.	Toray Group Safety Summit held and participation of overseas subsidiaries and affiliates began
2008	July	• <i>Oil prices surged to a new record of \$147 a barrel</i>
	Aug.	Group-wide Emergency Measures launched
	Sept.	• <i>Global Financial Crisis</i>
	Oct.	Received 2008 Humanitarian Award from the United Nations Association of New York
2009	Jan.	Permission for manufacturing and sales of ‘Remitch’ oral antipruritic drug received
	Apr.	Project IT-II mid-term management program launched
	July	Toray BlueStar Membrane Co., Ltd. (TBMC) established in China as a joint venture with China National BlueStar (Group) Co., Ltd.
	Oct.	• <i>Greek debt crisis emerged</i>
2010	Jan.	Toray Tonen Specialty Separator Godo Kaisha established as a joint venture (became wholly-owned subsidiary in January 2012 and changed its name to Toray Battery Separator Film Godo Kaisha in July 2012)
	Jan.	• <i>FTA enacted between China and ASEAN, creating the world’s largest free trade area</i>
	June	President Sadayuki Sakakibara became chairman & CEO and executive vice president Akihiro Nikkaku appointed president & COO
	Aug.	Toray Plastics (Hong Kong) Ltd. (TPHK) changed its name to Toray Plastics (China) Ltd. (TPCH) and positioned as a resin business headquarters in China
	Dec.	Toray Group Biodiversity Initiatives formulated
	-	• <i>China’s GDP overtook Japan’s to become the world’s second-largest economy</i>

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
2011	Mar.	• <i>Great East Japan Earthquake (magnitude 9.0) with over 18,000 people dead and missing</i>
	Apr.	AP-Growth TORAY 2020 long-term corporate vision and Project AP-G 2013 mid-term management program launched
	June	President Akihiro Nikkaku appointed CEO & COO
	June	Toray Medical (Qingdao) Co., Ltd. (TMQ) established in China as a joint venture with Qingdao Jifa Group Co., Ltd.
	July	• <i>Many Japanese manufacturers forced to halt operations due to flooding in Thailand (until around November)</i>
	Sept.	Toray India Representative Office opened (converted to subsidiary Toray Industries (India) Private Limited (TID) in January 2013)
	Sept.	Toray Advanced Materials Symposium 2011 and Toray Advanced Materials Exhibition 2011
	Nov.	New initiatives of Toray Global HR Management (G-HRM) launched
	2012	June
2013	Jan.	Toray Advanced Materials Korea Inc. (TAK) started production of carbon fiber
	Mar.	Ceremonies and exhibitions held to celebrate the 40th anniversary of business in Indonesia, the 50th anniversary in Thailand, and the 40th anniversary in Malaysia the following April
	Oct.	Applied for delisting from the stock exchanges in London, Luxembourg, Nagoya, Fukuoka, and Sapporo
2014	Feb.	All stock of Zoltek Companies, Inc. in the U.S. acquired to create a wholly-owned subsidiary
	Feb.	Woongjin Chemical Co., Ltd. acquired thorough TAK as a consolidated subsidiary (name changed to Toray Chemical Korea Inc. (TCK))
	Apr.	Project AP-G 2016 mid-term management program launched
	June	Outside director appointed for the first time
	June	• <i>Chairman Sadayuki Sakakibara appointed Chairman of Keidanren (Japan Business Federation)</i>
	July	Daily management of Proactive Management Program (PMP activities) launched

Year	Month	Toray Milestones/ <i>Social and Industrial Developments</i>
2014	Sept.	Toray Kusumgar Advanced Textile Private Limited (TKAT) established as a joint venture in India
2015	Apr.	Consolidated subsidiaries' account settlement day integrated to March 31, the same as Toray, from fiscal 2015
	June	• <i>Chinese stock market turbulence</i>
	Aug.	Toray Advanced Textile Mexico, S.A. de C.V. (TAMX) established in Mexico
	Dec.	Governance Committee established and Basic Policy on Corporate Governance formulated
2016	Feb.	• <i>Trans-Pacific Partnership (TPP) signed by 12 member countries (the U.S. later withdrew from the agreement)</i>
	Apr.	90th anniversary of founding celebrated
	Apr.	PPS resin polymerization production began at TAK's Gunsan Plant
	Apr.	Deployment of Toray Group Internal Control Self-monitoring and mutual inspection to all Group companies started
	July	Improvement by Monthly Follow-up (IMF) activities at some Japanese and overseas subsidiaries and affiliates began
	Oct.	Toray Advanced Materials Symposium 2016 and Toray Advanced Materials Exhibition 2016 held
2017	Apr.	TCA and CFA integrated to establish Toray Composite Materials America, Inc. (CMA)
	Apr.	Project AP-G 2019 mid-term management program launched
	Apr.	Toray Battery Separator Film Co., Ltd. (TBSF) absorbed, and BSF Division established within Films Division

Toray Group Companies outside Japan

Acronym	Corporate Name	Business	Country or Region
3TP*	3TM Plastics Co., Ltd.	C	Thailand
ACE	ACE Advanced Composite Engineering GmbH	D	Germany
ACTEM	P.T. Acryl Textile Mills	A	Indonesia
CENTEX	P.T. Century Textile Industry Tbk	A	Indonesia
CFA*	Toray Carbon Fibers America, Inc.	D	U.S.
CFE	Toray Carbon Fibers Europe S.A.	D	France
CIT	Composite Materials (Italy) S.r.l.	D	Italy
CMA	Toray Composite Materials America, Inc.	D	U.S.
EACC	Euro Advanced Carbon Fiber Composites GmbH	D	Germany
ETX	P.T. Easterntex	A	Indonesia
GNT	Greenerity GmbH	H	Germany
ISTEM	P.T. Indonesia Synthetic Textile Mills	A	Indonesia
ITS	P.T. Indonesia Toray Synthetics	AB	Indonesia
LCH*	LIBI Plastic Compounding (H.K.) Co., Ltd.	B	Hong Kong
LCS*	LIBI Plastic Compounding (Shenzhen) Co., Ltd.	B	China
LTX	Luckytex (Thailand) Public Company Ltd.	A	Thailand
NPT	Tianjin Pigment Engineering Plastics Co., Ltd.	B	China
PAB	Penfabric Sdn. Berhad	A	Malaysia
PCC	Plasan Carbon Composites, Inc.	D	U.S.
PFR	Penfibre Sdn. Berhad, Inc.	AC	Malaysia
STPS	Shanghai TPS Precision Co., Ltd.	B	China
TAFK	Toray Advanced Film Kaohsiung Co., Ltd.	B	Taiwan
TAK	Toray Advanced Materials Korea Inc.	ABCDE	Korea
TAL*	Textiles Alliance Ltd.	A	Hong Kong
TAM	Toray Industries (America), Inc.	H	U.S.
TAMX	Toray Advanced Textile Mexico, S.A. de C.V.	A	Mexico
TARC	Toray Advanced Materials Research Laboratories (China) Co., Ltd.	H	China
TAS	Toray Asia Pte. Ltd.	G	Singapore
TBCK	Toray BSF Coating Korea Limited	C	Korea
TBMC	Toray BlueStar Membrane Co., Ltd.	G	China
TBPR	Toray BASF PBT Resin Sdn. Berhad	B	Malaysia
TBSK	Toray Battery Separator Film Korea Limited	C	Korea
TCA*	Toray Composites (America), Inc.	D	U.S.
TCH	Toray Industries (China) Co., Ltd.	H	China
TCK	Toray Chemical Korea Inc.	ACG	Korea
TDG*	Toray Deutschland GmbH	H	Germany
TEL*	Toray Europe Ltd.	H	U.K.
TFCC	Cangzhou Toray Fine Chemicals Co., Ltd.	B	China
TFE	Toray Films Europe S.A.S.	C	France
TFH	Toray Film Products (Hong Kong) Ltd.	C	China
TFL*	Toray Fibers (Thailand) Ltd.	A	Thailand
TFN	TAK Advanced Film (Nantong) Co., Ltd.	C	China
TFNL	Toray Fibers (Nantong) Co., Ltd.	AG	China
TFRC	Toray Fibers & Textiles Research Laboratories (China) Co., Ltd.	H	China
TFZ	Toray Film Products (Zhongshan) Ltd.	C	China

Acronym	Corporate Name	Business	Country or Region
THK	Toray Industries (H.K.) Ltd.	H	China
TICH	Toray International (China) Co., Ltd.	H	China
TID	Toray Industries (India) Pvt. Ltd.	H	India
TIGT	Toray International Guangzhou Trading Co., Ltd.	H	China
TIHK	Toray International Trading (Hong Kong) Co., Ltd.	H	China
TJQ*	Toray Jifa (Qingdao) Textile Co., Ltd.	A	China
TKAT	Toray Kusumgar Advanced Textile Private Limited	A	India
TMA*	Toray Membrane America, Inc.	G	U.S.
TMBJ	Toray Membrane (Beijing) Co., Ltd.	G	China
TMEu	Toray Membrane Europe AG	G	Switzerland
TMME	Toray Membrane Middle East LLC	G	Saudi Arabia
TMQ	Toray Medical (Qingdao) Co., Ltd.	F	China
TMUS	Toray Membrane USA, Inc.	G	U.S.
TNT*	Toray Nylon Thai Co., Ltd.	AB	Thailand
TOMAC*	Toray Marketing & Sales (America), Inc.	H	U.S.
TPA	Toray Plastics (America), Inc.	C	U.S.
TPCD	Toray Plastics (Chengdu) Co., Ltd.	B	China
TPCH	Toray Plastics (China) Co., Ltd.	B	China
TPEU*	Toray Plastics Europe S.A.	C	France
TPHK*	Toray Plastics (Hong Kong) Ltd.	B	Hong Kong
TPJ	P.T. Toray Polytech Jakarta	A	Indonesia
TPM	Toray Plastics (Malaysia) Sdn. Berhad	B	Malaysia
TPN	Toray Polytech (Nantong) Co., Ltd.	A	China
TPPH	Toray Plastics Precision (Hong Kong) Ltd.	B	China
TPPZ	Toray Plastics Precision (Zhongshan) Ltd.	B	China
TPSU	Toray Plastics (Suzhou) Co., Ltd.	B	China
TPSZ	Toray Plastics (Shenzhen) Ltd.	B	China
TREC	Toray Resin Co.	B	U.S.
TRMX	Toray Resin Mexico, S.A. de C.V.	B	Mexico
TSCH	Toray Industries (South China) Co., Ltd.	H	China
TSD	Toray Sakai Weaving & Dyeing (Nantong) Co., Ltd.	A	China
TSI*	Toray Saehan Inc.	ABCE	Korea
TSP*	Toray Industries (Singapore) Pte. Ltd.	H	Singapore
TSW*	Toray Sakai Weaving (Nantong) Co., Ltd.	A	China
TTCE	Toray Textiles Central Europe s.r.o.	AE	Czech Republic
TTEL	Toray Textiles Europe Ltd.	A	U.K.
TTS	Thai Toray Synthetics Co., Ltd.	ABC	Thailand
TTTM	Thai Toray Textile Mills Public Company Ltd.	A	Thailand
TWMT	Toray WBD Membrane Technology (JS) Co., Ltd.	G	China
YTP	Yihua Toray Polyester Film Co., Ltd.	C	China

Notes | Acronym *: Corporate acronyms that are not currently used due to name changes, mergers, etc.

Business | A: Fibers and Textiles, B: Resins and Chemicals, C: Films, D: Carbon Fiber Composite Materials, E: Electronic and Information Materials, F: Pharmaceuticals and Medical Products, G: Water Treatment and Environment, H: Trading, Other Businesses

Corporate Outline

Corporate Name: Toray Industries, Inc.

Established: January 1926

President: Akihiro Nikkaku

Paid-in Capital: 147,873 million yen
(As of March 31, 2018)

Number of Countries/Regions Toray Operates in: 27
(As of March 31, 2018)

Number of Subsidiaries/Affiliates: 257 (Japan: 100, Overseas: 157)
(As of March 31, 2018)

Number of Employees: 45,762 (Toray: 7,625, Consolidated Japanese subsidiaries: 10,590,
(As of March 31, 2018) Consolidated overseas subsidiaries: 27,547)

Consolidated Net Sales: 2,204.9 billion yen
(Year ended March 31, 2018)

Consolidated Operating Income: 156.5 billion yen
(Year ended March 31, 2018)

Main Businesses: Manufacturing, processing and sales of the following products, among others:

- Fibers and Textiles** (Filament yarns, staple fibers, spun yarns, woven and knitted fabrics of nylon, polyester, acrylic and others; non-woven fabrics; ultra-microfiber non-woven fabric with suede texture; apparel products.)
- Performance Chemicals** (Nylon, ABS, PBT, PPS and other resins and molded products; polyolefin foam; polyester, polyethylene, polypropylene and other films and processed film products; raw materials for synthetic fibers and other plastics; fine chemicals; electronic and information materials and graphic materials.)
- Carbon Fiber Composite Materials** (Carbon fibers, carbon fiber composite materials and their molded products.)
- Environment and Engineering** (Comprehensive engineering; condominiums; industrial equipment and machinery; information-related equipment; water treatment membranes and related equipment; materials for housing, building and civil engineering applications.)
- Life Science** (Pharmaceuticals; medical devices, etc.)
- Others** (Analysis, physical evaluation, research, and other services.)



'TORAY'
Innovation by Chemistry