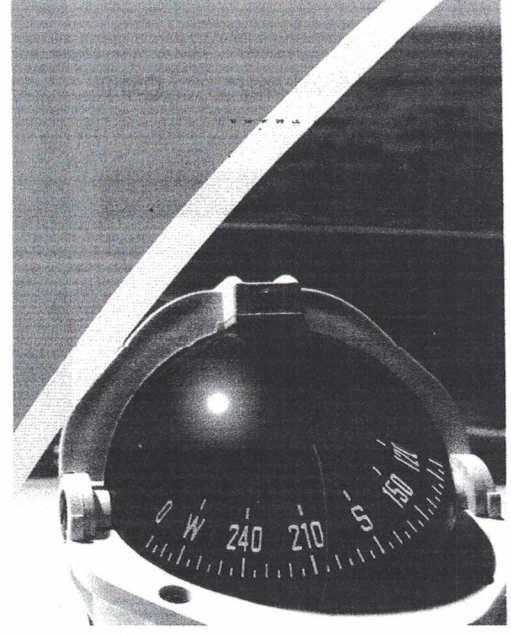

CASE 16

TOYOTA: LEAN PRODUCTION AND THE RISE OF THE WORLD'S LARGEST AUTOMOBILE MANUFACTURER

INTRODUCTION

The growth of Toyota has been one of the great success stories of Japanese industry during the last half century. In 1947, the company was a little-known domestic manufacturer producing around 100,000 vehicles a year. In 2012, Toyota sold 9.4 million light vehicles globally, making it the largest automobile manufacturer in the world, ahead of Volkswagen with 9.1 million units sold and GM with 7.7 million units.

For all of its success, however, recent years have been challenging for Toyota. As a consequence of the global financial crisis, demand for vehicles fell sharply in 2008 and 2009, pushing most of the world's major automobile companies into the red. GM, one of Toyota's main global rivals, filed for Chapter 11 bankruptcy protection in 2009. However, the GM that emerged from Chapter 11 2 years later was a leaner, more viable competitor to Toyota. At the same time, the South Korean company, Hyundai-Kia, emerged from the financial crisis in a strong position as the fourth-largest automobile manufacturer in the world and the most profitable. Volkswagen too was strengthening its position and closing in on Toyota in terms of sales volume.

Not only did Toyota face stronger global rivals than hitherto, its own position was damaged when a series of product recalls, mostly in the United States, tarnished its brand and corporate image. The most infamous of these was the "sticky accelerator pedal" issue that allegedly led to sudden uncontrolled vehicle acceleration and in some cases serious accidents. Toyota recalled some 9 million vehicles to in 2009–2010, the largest product recall in industry history, and temporarily suspended some sales while it tried to identify and solve the issue. An investigation by the U.S. National Highway Transport & Safety Agency found no electronic fault with Toyota's "drive-by-wire" throttle system, which was initially blamed for the issue, and instead attributed the problem to mechanical causes (including pedals caught under floor mats), and "driver error." Irrespective of the failure to identify a clear cause, in 2012 Toyota agreed to pay $1.1 billion to settle a class action lawsuit related to the issue. More importantly perhaps, Toyota's legendary reputation for product quality had taken a major blow. The questions facing Toyota's management were, how

could they reestablish the company as the undisputed leader in quality, and how could they fend off stronger competitors in a rapidly globalizing marketplace?

THE ORIGINS OF TOYOTA

The original idea behind the founding of the Toyota Motor Company came from the fertile mind of Toyoda Sakichi.[1] The son of a carpenter, Sakichi was an entrepreneur and inventor whose primary interest lay in the textile industry, but he had been intrigued by automobiles since a visit to the United States in 1910. Sakichi's principal achievement was the invention of an automatic loom that held the promise of being able to lower the costs of weaving high-quality cloth. In 1926, Sakichi set up Toyoda Automatic Loom to manufacture this product. In 1930, he sold the patent rights to a British textile concern, Platt Brothers, for about 1 million yen, a considerable sum in those days. Sakichi urged his son, Toyoda Kiichiro, to use this money to study the possibility of manufacturing automobiles in Japan. In 1930, Kiichiro, a mechanical engineer with a degree from the University of Tokyo, became managing director of loom production at Toyoda Automatic Loom.

Kiichiro was at first reluctant to invest in automobile production. The Japanese market was at that time dominated by Ford and General Motors, both of which imported knock-down car kits from the United States and assembled them in Japan. Given this, the board of Toyoda Automatic Loom, including Kiichiro's brother-in-law and the company's president, Kodama Risaburo, opposed the investment on the grounds that it was too risky. Kiichiro probably would not have pursued the issue further had not his father made a deathbed request in 1930 that Kiichiro explore the possibilities of automobile production. Kiichiro had to push but, in 1933, he secured permission to set up an automobile department within Toyoda Automatic Loom.

Kiichiro's belief was that he would be able to figure out how to manufacture automobiles by taking apart U.S.-made vehicles and examining them piece by piece. He also felt that it should be possible to adapt U.S. mass-production technology to manufacture cost efficiently at lower volumes. His confidence was based in large part upon the already considerable engineering skills and capabilities at his disposal through Toyoda Automatic Loom. Many of the precision engineering and manufacturing skills needed in automobile production were similar to the skills required to manufacture looms.

Kiichiro produced his first 20 vehicles in 1935, and in 1936 the automobile department produced 1,142 vehicles—910 trucks, 100 cars, and 132 buses. At this time, however, the production system was essentially craft based rather than a modern assembly line. Despite some progress, the struggle might still have been uphill had not fate intervened in the form of the Japanese military. Japan had invaded Manchuria in 1931 and quickly found American-made trucks useful for moving men and equipment. As a result, the military felt that it was strategically important for Japan to have its own automobile industry. The result was the passage of an automobile manufacturing law in 1936 that required companies producing more than 3,000 vehicles per year in Japan to get a license from the government. Moreover, to get a license, over 50% of the stock had to be owned by Japanese investors. The law also placed a duty on imported cars, including the knock-down kits that Ford and GM brought into Japan. As a direct result of this legislation, both GM and Ford exited the Japanese market in 1939.

Once the Japanese government passed this law, Kodama Risaburo decided that the automobile venture could be profitable and switched from opposing to proactively supporting Kiichiro (in fact, Risaburo's wife, who was Kiichiro's elder sister, had been urging him to take this step for some time). The first priority was to attract the funds necessary to build a mass-production facility. In 1937, Risaburo and Kiichiro decided to incorporate the automobile department as a separate company in order to attract outside investors—which they were successful in doing. Kiichiro Toyoda was appointed president of the new company. The company was named the Toyota Motor Company. (The founding family's name, "Toyoda," means "abundant rice field" in Japanese. The new name had no meaning in Japanese.)

Upon incorporation, Risaburo and Kiichiro's vision was that Toyota should expand its passenger car production as quickly as possible. However, once again fate intervened in the form of the Japanese

military. Toyota had barely begun passenger car production when war broke out; in 1939, the Japanese government, on advice from the military, prohibited passenger car production and demanded that the company specialize in the production of military trucks.

THE EVOLUTION OF THE TOYOTA PRODUCTION SYSTEM

After the end of World War II, Kiichiro was determined that Toyota should reestablish itself as a manufacturer of automobiles.[2] Toyota, however, faced a number of problems in doing this:

1. The Japanese domestic market was too small to support efficient-scale, mass-production facilities such as those common in America by that time.
2. The Japanese economy was starved for capital, which made it difficult to raise funds to finance new investments.
3. New labor laws introduced by the American occupiers increased the bargaining power of labor and made it difficult for companies to lay off workers.
4. North America and Western Europe were full of large auto manufacturers eager to establish operations in Japan.

In response to the last point, in 1950, the new Japanese government prohibited direct foreign investment in the automobile industry and imposed high tariffs on the importation of foreign cars. This protection, however, did little to solve the other problems facing the company at this time.

Limitations of Mass Production

At this juncture, a remarkable mechanical engineer entered the scene: Taiichi Ohno. More than anyone else, it was Ohno who was to work out a response to the above problems. Ohno had joined Toyoda Spinning and Weaving in 1932 as a production engineer in cotton thread manufacture and entered Toyota when the former company was absorbed into the latter in 1943. Ohno worked in auto production for 2 years, was promoted and managed auto assembly and machine shops between 1945 and 1953, and in 1954 was appointed a company director.

When Taiichi Ohno joined Toyota, the mass-production methods pioneered by Ford had become the accepted method of manufacturing automobiles. The basic philosophy behind mass production was to produce a limited product line in massive quantities to gain maximum economies of scale. The economies came from spreading the fixed costs involved in setting up the specialized equipment required to stamp body parts and manufacture components over as large a production run as possible. Since setting up much of the equipment could take a full day or more, the economies involved in long production runs were reckoned to be considerable. Thus, for example, Ford would stamp 500,000 right-hand door panels in a single production run, and then store the parts in warehouses until they were needed in the assembly plant, rather than stamp just those door panels that were needed immediately and then change the settings and stamp out left-hand door panels or other body parts.

A second feature of mass production was that each assembly worker should perform only a single task, rather than a variety of tasks. The idea was that, as the worker became completely familiar with a single task, he could perform it much faster, thereby increasing labor productivity. Assembly-line workers were overseen by a foreman who did not perform any assembly tasks but instead ensured that workers followed orders. In addition, a number of specialists were employed to perform nonassembly operations such as tool repair, die changes, quality inspection, and general "housecleaning."

After working at Toyota for 5 years and visiting Ford's U.S. plants, Ohno became convinced that the basic mass-production philosophy was flawed. He saw five problems with the mass-production system:

1. Long production runs created massive inventories that had to be stored in large warehouses. This was expensive both because of the cost of warehousing and because inventories tied up capital in unproductive uses.
2. If the initial machine settings were wrong, long production runs resulted in the production of a large number of defects.

3. The sheer monotony of assigning assembly-line workers to a single task generated defects, since workers became lax about quality control. In addition, since workers were not responsible for quality control, they had little incentive to minimize defects.
4. The extreme division of labor resulted in the employment of specialists such as foremen, quality inspectors, and tooling specialists, whose jobs logically could be performed by assembly-line workers.
5. The mass-production system was unable to accommodate consumer preferences for product diversity.

In addition to these flaws, Ohno knew that the small domestic market in Japan and the lack of capital for investing in mass-production facilities made the American model unsuitable for Toyota.

Reducing Setup Times

Given these flaws and the constraints that Toyota faced, Ohno decided to take a fresh look at the techniques used for automobile production. His first goal was to try to make it economical to manufacture auto body parts in small batches. To do this, he needed to reduce the time it took to set up the machines for stamping out body parts. Ohno and his engineers began to experiment with a number of techniques to speed up the time it took to change the dies in stamping equipment. This included using rollers to move dies in and out of position, along with a number of simple adjustment mechanisms to fine-tune the settings. These techniques were relatively simple to master, so Ohno directed production workers to perform the die changes themselves. This in itself reduced the need for specialists and eliminated the idle time that workers previously had enjoyed while waiting for the dies to be changed.

Through a process of trial and error, Ohno succeeded in reducing the time required to change dies on stamping equipment from a full day to 15 minutes by 1962, and to as little as 3 minutes by 1971. By comparison, even in the early 1980s, many American and European plants required anywhere between 2 and 6 hours to change dies on stamping equipment. As a consequence, American and European plants found it economical to manufacture in lots equivalent to 10 to 30 days' supply and to reset equipment only every other day. In contrast, since Toyota could change the dies on stamping equipment in a matter of minutes, it manufactured in lots equivalent to just 1 day's supply, while resetting equipment three times per day.

Not only did these innovations make small production runs economical, but they also had the added benefit of reducing inventories and improving product quality. Making small batches eliminated the need to hold large inventories, thereby reducing warehousing costs and freeing up scarce capital for investment elsewhere. Small production runs and the lack of inventory also meant that defective parts were produced only in small numbers and entered the assembly process almost immediately. This had the added effect of making workers in the stamping shops far more attentive to quality. In addition, once it became economical to manufacture small batches of components, much greater variety could be included in the final product at little or no cost penalty.

Organization of the Workplace

One of Ohno's first innovations was to group the workforce into teams. Each team was given a set of assembly tasks to perform, and team members were trained to perform each task for which the team was responsible. Each team had a leader who was also an assembly-line worker. In addition to coordinating the team, the team leader was expected to perform basic assembly-line tasks and to fill in for any absent worker. The teams were given the job of housecleaning, minor tool repair, and quality inspection (along with the training required to perform these tasks). Time was also set aside for team members to discuss ways to improve the production process (the practice now referred to as "quality circles").

The immediate effect of this approach was to reduce the need for specialists in the workplace and to create a more flexible workforce in which individual assembly-line workers were not treated simply as human machines. All of this resulted in increased worker productivity.

None of this would have been possible had it not been for an agreement reached between management and labor after a 1950 strike. The strike was brought on by management's attempt to cut the workforce by 25% (in response to a recession in Japan). After lengthy negotiations, Toyota and the union worked out a compromise. The workforce was cut by 25%,

as originally proposed, but the remaining employees were given two guarantees: one for lifetime employment and the other for pay graded by seniority and tied to company profitability through bonus payments. In exchange for these guarantees, employees agreed to be flexible in work assignments. In turn, this allowed for the introduction of the team concept.

Improving Quality

One standard practice in the mass-production auto assembly plants was to fix errors that occurred during assembly in a rework area at the end of the assembly line. Errors routinely occurred in most assembly plants either because bad parts were installed or because good parts were installed incorrectly. The belief was that stopping an assembly line to fix such errors would cause enormous bottlenecks in the production system. Thus, it was thought to be more efficient to correct errors at the end of the line.

Ohno viewed this system as wasteful for three reasons: (1) since workers understood that any errors would be fixed at the end of the line, they had little incentive to correct errors themselves; (2) once a defective part had been embedded in a complex vehicle, an enormous amount of rework might be required to fix it; and (3) since defective parts were often not discovered until the end of the line when the finished cars were tested, a large number of cars containing the same defect may have been built before the problem was found.

In an attempt to eliminate this practice, Ohno sought ways to reduce the amount of rework at the end of the line. His approach involved two elements. First, he placed a cord above every workstation and instructed workers to stop the assembly line if a problem emerged that could not be fixed. It then became the responsibility of the whole team to work on the problem. Second, team members were taught to trace every defect back to its ultimate cause and then to ensure that the problem was fixed so that it would not reoccur.

Initially, this system produced enormous disruption. The production line was stopping all the time, and workers became discouraged. However, as team members gained experience in identifying problems and tracing them back to their root cause, the number of errors began to drop dramatically and stops in the line became much rarer. Today, in most Toyota plants, the line virtually never stops.

Developing the Kanban System

Once reduced setup times had made small production runs economical, Ohno began to look for ways to coordinate the flow of production within the Toyota manufacturing system so that the amount of inventory in the system could be reduced to a minimum. Toyota produced about 25% of its major components in-house (the rest were contracted out to independent suppliers). Ohno's initial goal was to arrange for components and/or subassemblies manufactured in-house to be delivered to the assembly floor only when they were needed, and not before (this goal was later extended to include independent suppliers).

To achieve this, in 1953, Ohno began experimenting with what came to be known as the kanban system. Under the kanban system, component parts are delivered to the assembly line in containers. As each container is emptied, it is sent back to the previous step in the manufacturing process. This then becomes the signal to make more parts. The system minimizes work in progress by increasing inventory turnover. The elimination of buffer inventories also means that defective components show up immediately in the next process. This facilitates the process of tracing defects back to their source and correcting the problem before too many defects are made. Moreover, the elimination of buffer stocks, by removing all safety nets, makes it imperative that problems be solved before they become serious enough to jam up the production process, thereby creating a strong incentive for workers to ensure that errors are corrected as quickly as possible. In addition, by decentralizing responsibility for coordinating the manufacturing process to lower-level employees, the kanban system does away with the need for extensive centralized management to coordinate the flow of parts between the various stages of production.

After perfecting the kanban system in one of Toyota's machine shops, Ohno had a chance to apply the system broadly in 1960 when he was made general manager of the Motomachi assembly plant. Ohno already had converted the machining, body stamping, and body shops to the kanban system, but since many parts came from shops that had yet to adopt the system, or from outside suppliers, the impact on inventories was initially minimal. However, by 1962, he had extended kanban to forging and casting, and between 1962 and 1965, he began to bring independent suppliers into the system.

Organizing Suppliers

Assembly of components into a final vehicle accounts for only about 15% of the total manufacturing process in automobile manufacture. The remaining 85% of the process involves manufacturing more than 10,000 individual parts and assembling them into about 100 major components such as engines, suspension systems, transaxles, and so on. Coordinating this process so that everything comes together at the right time has always been a problem for auto manufacturers. Historically, the response at Ford and GM to this problem was massive vertical integration. The belief was that control over the supply chain would allow management to coordinate the flow of component parts into the final assembly plant. In addition, American firms held the view that vertical integration made them more efficient by reducing their dependence on other firms for materials and components and by limiting their vulnerability to opportunistic overcharging.

As a consequence of this philosophy, even as late as the mid-1990s, General Motors made 68% of its components in-house, while Ford made 50% (in the late 1990s, both GM and Ford de-integrated, spinning off many of their in-house supply operations as independent enterprises). When they didn't vertically integrate, U.S. auto companies historically tried to reduce the procurement costs that remain through competitive bidding—several companies to submit contracts and placing orders with suppliers offering the lowest price.

Under the leadership of Kiichiro Toyoda during the 1930s and 1940s, Toyota followed the American model and pursued extensive vertical integration into the manufacture of component parts. In fact, Toyota had little choice in this matter, because only a handful of Japanese companies were able to make the necessary components. However, the low volume of production during this period meant that the scale of integration was relatively small. In the 1950s, however, the volume of auto production began to increase dramatically. This presented Toyota with a dilemma: Should the company increase its capacity to manufacture components in-house, in line with the growth in auto production, or should it contract out?

In contrast to American practice, the company decided that, while it should increase in-house capacity for essential subassemblies and bodies, it would do better to contract out for most components. Four reasons seemed to bolster this decision:

1. Toyota wanted to avoid the capital expenditures required to expand capacity to manufacture a wide variety of components.
2. It wanted to reduce risk by maintaining a low factory capacity in case factory sales slumped.
3. It wanted to take advantage of the lower wage scales in smaller firms.
4. Toyota managers realized that in-house manufacturing offered few benefits if it was possible to find stable, high-quality, low-cost external sources of component supply.

At the same time, Toyota managers felt that the American practice of inviting competitive bids from suppliers was self-defeating. While competitive bidding might achieve the lowest short-run costs, the practice of playing suppliers off against each other did not guarantee stable supplies, high quality, or cooperation beyond existing contracts to solve design or engineering problems. Ohno and other Toyota managers believed that real efficiencies could be achieved if the company entered into long-term relationships with major suppliers. This would allow them to introduce the kanban system, thereby further reducing inventory holding costs and realizing the same kind of quality benefits that Toyota was already beginning to encounter with its in-house supply operations. In addition, Ohno wanted to bring suppliers into the design process because he believed they might suggest ways of improving the design of component parts based upon their own manufacturing experience.

As it evolved during the 1950s and 1960s, Toyota's strategy toward its suppliers had several elements. The company spun off some of its in-house supply operations into quasi-independent entities in which it took a minority stake, typically holding between 20 and 40% of the stock. It then recruited a number of independent companies with a view to establishing a long-term relationship with them for the supply of critical components. Sometimes, but not always, Toyota took a minority stake in these companies as well. All of these companies were designated as "first-tier suppliers." First-tier suppliers were responsible for working with Toyota as an integral part of the new product development team. Each first tier was responsible for the formation of a "second tier" of suppliers under its

direction. Companies in the second tier were given the job of fabricating individual parts.

Both first- and second-tier suppliers were formed into supplier associations.

By 1986, Toyota had three regional supply organizations in Japan with 62, 135, and 25 first-tier suppliers. A major function of the supplier associations was to share information regarding new manufacturing, design, or materials management techniques among themselves. Concepts such as statistical process control, total quality control, and computer-aided design were rapidly diffused among suppliers by this means.

Toyota also worked closely with its suppliers, providing them with management expertise, engineering expertise, and sometimes capital to finance new investments. Critical to this relationship were the incentives that Toyota established to encourage its suppliers to focus on realizing continuous process improvements. The basic contract for a component would be for 4 to 5 years, with the price being agreed upon in advance. If by joint efforts the supplier and Toyota succeeded in reducing the costs of manufacturing the components, the additional profit would be shared between the two. If the supplier by its own efforts came up with an innovation that reduced costs, the supplier would keep the additional profit that the innovation generated for the lifetime of the contract.

As a consequence of this strategy, Toyota outsourced more production than almost any other major auto manufacturer. By the late 1980s, Toyota was responsible for only about 27% of the value going into a finished automobile, with the remainder coming from outside suppliers. In contrast, at the time General Motors was responsible for about 70% of the value going into a finished automobile. Other consequences included long-term improvements in productivity and quality among Toyota's suppliers that were comparable to the improvements achieved by Toyota itself. In particular, extension of the kanban system to include suppliers, by eliminating buffer inventory stocks, in essence forced suppliers to focus more explicitly on the quality of their product.

Consequences

The consequences of Toyota's production system included a surge in labor productivity and a decline in the number of defects per car. Figure 1 compares the number of vehicles produced per worker at General Motors, Ford, Nissan, and Toyota between 1965 and 1983.

These figures are adjusted for the degree of vertical integration pursued by each company. As can be seen, in 1960, productivity at Toyota already outstripped that of Ford, General Motors, and its main Japanese competitor, Nissan. As Toyota refined its production system over the next 18 years, productivity doubled. In comparison, productivity essentially stood still at General Motors and Ford during the same period.

Figure 2 provides another way to assess the superiority of Toyota's production system. Here the performance of Toyota's Takaoka plant is compared

Figure 1 Vehicles Produced per Worker (adjusted for vertical integration), 1965–1983

Year	General Motors	Ford	Nissan	Toyota
1965	5.0	4.4	4.3	8.0
1970	3.7	4.3	8.8	13.4
1975	4.4	4.0	9.0	15.1
1979	4.5	4.2	11.1	18.4
1980	4.1	3.7	12.2	17.8
1983	4.8	4.7	11.0	15.0

Source: M. A. Cusumano, *The Japanese Automotive Industry* (Cambridge, Mass.: Harvard University Press, 1989), p. 197.

Figure 2 General Motors's Framingham Plant versus Toyota's Takaoka Plant, 1987

	GM Framingham	Toyota Takaoke
Assembly hours per car	31	16
Assembly defects per 100 cars	135	45
Inventory of parts	2 weeks	2 hours

Source: J. P. Womack, D. T. Jones, and D. Roos, *The Machine That Changed the World* (New York: Macmillan, 1990), p. 83.

with that of General Motors's Framingham plant in 1987. As can be seen, the Toyota plant was more productive, produced far fewer defects per 100 cars, and kept far less inventory on hand.

A further aspect of Toyota's production system is that the short setup times made it economical to manufacture a much wider range of models than is feasible at a traditional mass-production assembly plant. In essence, Toyota soon found that it could supply much greater product variety than its competitors with little in the way of a cost penalty. In 1990, Toyota was offering consumers around the world roughly as many products as General Motors (about 150), even though Toyota was still only half GM's size. Moreover, it was doing this at a lower cost than GM.

DISTRIBUTION AND CUSTOMER RELATIONS

Toyota's approach to its distributors and customers as it evolved during the 1950s and 1960s was in many ways just as radical as its approach toward suppliers. In 1950, Toyota formed a subsidiary, Toyota Motor Sales, to handle distribution and sales. The new subsidiary was headed by Kaymiya Shotaro from its inception until 1975. Kaymiya's philosophy was that dealers should be treated as "equal partners" in the Toyota family. To back this up, he had Toyota Motor Sales provide a wide range of sales training and service training for dealership personnel.

Kaymiya then used the dealers to build long-term ties with Toyota's customers. The ultimate aim was to bring customers into the Toyota design and production process. To this end, through its dealers, Toyota Motor Sales assembled a huge database on customer preferences. Much of the data came from monthly or semiannual surveys conducted by dealers asking Toyota customers about their preferences for styling, model types, colors, prices, and other features. Toyota also used these surveys to estimate the potential demand for new models. This information was then fed directly into the design process.

Kaymiya began this process in 1952, when the company was redesigning its Toyopet model. The Toyopet was primarily used by urban taxi drivers. Toyota Motor Sales surveyed taxi drivers to try to find out what type of vehicle they preferred. They wanted something reliable, inexpensive, and with good city fuel mileage—which Toyota engineers then set about designing. In 1956, Kaymiya formalized this process when he created a unified department for planning and market research whose function was to coordinate the marketing strategies developed by researchers at Toyota Motor Sales with product planning by Toyota's design engineers. From this time on, marketing information played a critical role in the design of Toyota's cars and in the company's strategy. In particular, it was the research department at Toyota Motor Sales that provided the initial stimulus for Toyota to start exporting during the late 1960s after predicting, correctly, that growth in domestic sales would slow down considerably during the 1970s.

Expanding Internationally

Large-scale overseas expansion did not become feasible at Toyota until the late 1960s, for one principal reason: Despite the rapid improvement in productivity, Japanese cars were still not competitive.[3] In 1957,

for example, the Toyota Corona sold in Japan for the equivalent of $1,694. At the same time, the Volkswagen Beetle sold for $1,111 in West Germany, while Britain's Austin company was selling its basic model for the equivalent of $1,389 in Britain. Foreign companies were effectively kept out of the Japanese market, however, by a 40% value-added tax and shipping costs.

Despite these disadvantages, Toyota tried to enter the U.S. market in the late 1950s. The company set up a U.S. subsidiary in California in October 1957 and began to sell cars in early 1958, hoping to capture the American small-car market (which at that time was poorly served by the U.S. automobile companies). The result was a disaster. Toyota's cars performed poorly in road tests on U.S. highways. The basic problem was that the engines of Toyota's cars were too small for prolonged, high-speed driving and tended to overheat and burn oil, while the poorly designed chassis resulted in excessive vibration. Sales were slow and, in 1964, Toyota closed its U.S. subsidiary and withdrew from the market.

The company was determined to learn from its U.S. experience and quickly redesigned several of its models based on feedback from American consumer surveys and U.S. road tests. As a result, by 1967, the picture had changed considerably. The quality of Toyota's cars was now sufficient to make an impact in the U.S. market, while production costs and retail prices had continued to fall and were now comparable with international competitors in the small-car market.

In the late 1960s, Toyota reentered the U.S. market. Although sales were initially slow, they increased steadily. Then the OPEC-engineered, four-fold increase in oil prices that followed the 1973 Israeli-Arab conflict gave Toyota an unexpected boost. U.S. consumers began to turn to small, fuel-efficient cars in droves, and Toyota was one of the main beneficiaries. Driven primarily by a surge in U.S. demand, worldwide exports of Toyota cars increased from 157,882 units in 1967 to 856,352 units by 1974 and to 1,800,923 units by 1984. Put another way, in 1967 exports accounted for 19% of Toyota's total output. By 1984, they accounted for 52.5%.

Success brought its own problems. By the early 1980s, political pressures and talk of local content regulations in the United States and Europe were forcing an initially reluctant Toyota to rethink its exporting strategy. Toyota already had agreed to "voluntary" import quotas with the United States in 1981. The consequence for Toyota was stagnant export growth between 1981 and 1984. Against this background, in the early 1980s Toyota began to think seriously about setting up manufacturing operations overseas.

Transplant Operations

Toyota's first overseas operation was a 50-50 joint venture with General Motors established in February 1983 under the name New United Motor Manufacturing, Inc. (NUMMI). NUMMI, based in Fremont, California, began producing Chevrolet Nova cars for GM in December 1984.[4] The maximum capacity of the Fremont plant is about 250,000 cars per year.

For Toyota, the joint venture provided a chance to find out whether it could build quality cars in the United States using American workers and American suppliers. It also provided Toyota with experience dealing with an American union (the United Auto Workers Union) and with a means of circumventing "voluntary" import restrictions. For GM, the venture provided an opportunity to observe in full detail the Japanese approach to manufacturing. While GM's role was marketing and distributing the plant's output, Toyota designed the product and designed, equipped, and operated the plant. At the venture's start, 34 executives were loaned to NUMMI by Toyota, and 16 by General Motors. The chief executive and chief operating officer were both Toyota personnel.

By Fall 1986, the NUMMI plant was running at full capacity and early indications were that the NUMMI plant was achieving productivity and quality levels close to those achieved at Toyota's major Takaoka plant in Japan. For example, in 1987, it took the NUMMI plant 19 assembly hours to build a car, compared to 16 hours at Takaoka, while the number of defects per 100 cars was the same at NUMMI as at Takaoka—45.[5]

Encouraged by its success at NUMMI, Toyota announced in December 1985 that it would build an automobile manufacturing plant in Georgetown, Kentucky. The plant, which came on stream in May 1988, officially had the capacity to produce 200,000 Toyota Camrys a year. Such was the success of this plant, however, that by early 1990 it was producing the equivalent of 220,000 cars per year. This success was followed by an announcement in December 1990 that Toyota would build a second plant in Georgetown with a capacity to produce a further 200,000 vehicles per year.[6]

By 2012, Toyota had 14 vehicle assembly plants in North America, 10 of them in the United States, which collectively produced 7 out of every 10 Toyota cars sold in the region. In addition, the company had six other plants producing a range of components, including engines and transmissions. The company also has two R&D and design centers in the United States, its only such facilities outside of Japan. By 2012, Toyota's cumulative investment in the United States exceeded $19.5 billion. In April 2013, Toyota announced that it would move production of one of its luxury Lexus vehicles from Japan to the United States, marking the first time that the company had produced a luxury vehicle outside of Japan. At the same time, Toyota announced that it would invest another $2.5 billion to expand U.S. production capacity.[7]

In addition to its North American transplant operations, Toyota moved to set up production in Europe in anticipation of the 1992 lowering of trade barriers among the 12 members of the European Economic Community. In 1989, the company announced that it would build a plant in England with the capacity to manufacture 200,000 cars per year by 1997. It opened a second plant in France in 2001, and by 2008, Toyota had four assembly plants in Europe with a total production capacity of 800,000 vehicles.

The company also expanded into China during the first decade of the 20th century. In China, it had three assembly plants by 2008 that were capable of producing over 440,000 vehicles a year. In the rest of Southeast Asia, Toyota had another 10 plants that could produce almost 1 million vehicles. There were also sizable assembly plants in South Africa, Australia, and South America.

Despite Toyota's apparent commitment to expand global assembly operations, it was not all smooth sailing. One problem was building an overseas supplier network comparable to Toyota's Japanese network. For example, in a 1990 meeting of Toyota's North American suppliers' association, Toyota executives informed their North American suppliers that the defect ratio for parts produced by 75 North American and European suppliers was 100 times greater than the defect ratio for parts supplied by 147 Japanese suppliers—1,000 defects per million parts versus 10 defects per million among Toyota's Japanese suppliers. Moreover, Toyota executives pointed out that parts manufactured by North American and European suppliers tend to be significantly more expensive than comparable parts manufactured in Japan.

Because of these problems, Toyota had to import many parts from Japan for its U.S. assembly operations. However, for political reasons, Toyota was being pushed to increase the local content of cars assembled in North America. By the mid-2000s, the local content of cars produced in North America was over 70%. To improve the efficiency of its U.S.-based suppliers, Toyota embarked upon an aggressive supplier education process. In 1992, it established the Toyota Supplier Support Center to teach its suppliers the basics of the Toyota production system. By the mid-2000s, over 100 supplier companies had been through the center. Many had reportedly seen double- and triple-digit productivity growth as a result, as well as dramatic reductions in inventory levels.[8]

Product Strategy

Toyota's initial production was aimed at the small-car/basic transportation end of the automobile market. This was true both in Japan and of its export sales to North America and Europe. During the 1980s, however, Toyota progressively moved up market and abandoned much of the lower end of the market to new entrants such as the South Koreans. Thus, the company's Camry and Corolla models, which initially were positioned toward the bottom of the market, have been constantly upgraded and now are aimed at the middle-income segments of the market. This upgrading reflects two factors: (1) the rising level of incomes in Japan and the commensurate increase in the ability of Japanese consumers to purchase mid-range and luxury cars and (2) a desire to hold on to its U.S. consumers, many of whom initially purchased inexpensive Toyotas in their early 20S and who have since traded up to more expensive models.

The upgrading of Toyota's models reached a logical conclusion in September 1989, when the company's Lexus division began marketing luxury cars to compete with Jaguars, BMWs, and the like. Although the Lexus brand initially got off to a slow start—in large part due to an economic recession—by 2001, Toyota was selling over 200,000 Lexus models a year in the United States, making it the bestselling luxury brand in the country.

In the mid-1990s, Toyota's U.S. research suggested that the company was losing younger buyers to hipper

brands like Volkswagen. The result was a brand designed especially for the U.S. market, the Scion. Established with its own dealer network, the Scion has been a hit for Toyota.

TOYOTA IN 2000–2012

The first 8 years of the 21st century were ones of solid growth for Toyota. In 2004, it overtook Ford to become the second-largest car company in the world. The company surpassed GM in 2008, and seemed on track to meet its goal of capturing 15% of the global automobile market by 2010. Toyota was now a truly international company. Its overseas operations had grown from 11 production facilities in 9 countries in 1980 to 48 production facilities in 26 countries around the world.[9] In the important United States market, the world's largest, Toyota held an 18.4% share of passenger car sales in mid-2008, up from 11% in 2000. Ford's share was 15.4%, while GM held on to a 19.3% share.[10]

The company was very profitable. In the financial year ending March 2008, it earned $17.5 billion in net profits on sales of $183 billion. Both GM and Ford lost money that year.

According to data from J. D. Power, Toyota was the quality leader in the U.S. market in 2008. For cars that had been on the market for over 3 years, Toyota's Lexus brand led the pack for the 14th consecutive year, with 120 problems per 100 vehicles, compared to an industry average of 206 problems per 100 vehicles. The Toyota brand had 159 problems per 100 vehicles, compared to 177 for Honda, 204 for Ford, 226 for GMC, 229 for Chrysler, and 253 for Volkswagen. Toyota also had a strong record in the industry when measured by problems reported in the first 90 days after a sale—99 problems per 100 cars for the Lexus brand and 104 for the Toyota brand, versus an industry average of 118 problems per 100 cars.[11]

J. D. Power also found that Toyota led the market in Japan. A survey found that for vehicles purchased in 2002, Toyota had 89 problems per 100 vehicles compared to an industry average of 104. Honda was next, with 91 problems per 100 vehicles, followed by Nissan, with 108 problems per 100 vehicles.[12]

On the productivity front, Toyota's lead seemed to have narrowed. While it was clearly the productivity leader in the United States in 2003, where it took an average of 30.1 hours to make a car, compared to 35.2 hours at General Motors and 38.6 hours at Ford, by 2007 Toyota was taking 30.37 hours to build a car, compared to 32.29 hours at GM and 33.88 hours at Ford.[13] On the other hand, according to J.D. Power, Toyota had the three most efficient assembly plants in the world, all located in Japan.[14]

Higher quality and greater productivity helped Toyota make far more money per car than its large rivals. In 2007, Toyota made a pretax profit of $922 per vehicle in the United States, compared with losses of $729 and $1,467 at GM and Ford, respectively. These losses also reflect the fact that Ford and GM still pay more for health care, pensions, and sales incentives than does Toyota. Also, Ford and GM support more dealers relative to their market share than does Toyota.[15]

Toyota's ability to stay on top of productivity and quality rankings can be attributed to a companywide obsession with continuing to improve the efficiency and effectiveness of its manufacturing operations. The latest round of these was initiated in 2000, by Toyota President Fujio Cho. Cho, who worked for a while under Toyota's legendary engineer, Taiichi Ohno, introduced an initiative known as "Construction of Cost Competitiveness for the 21st Century," or CCC21. The initiative has as a goal slashing component part

Figure 3 Total Manufacturing Productivity in the U.S. Automobile Industry (total labor hours per unit)

Company	2003	2007
Ford	38.6	33.88
Chrysler	37.42	30.37
General Motors	35.2	32.39
Nissan	32.94	32.96
Honda	32.36	31.33
Toyota	30.01	30.37

Note: Includes assembly, stamping, engine, and transmission plants.
Source: O. Wyman, *Oliver Wyman's Harbour Report*, June 2008.

costs by 30% on all new models. Attaining this goal necessitated Toyota working closely with suppliers—something it has long done.

By the mid-2000s, Toyota was close to attaining its CCC21 goal. In implementing CCC21, no detail has been too small. For example, Toyota took a close look at the grip handles mounted above the doors inside most cars. By working closely with suppliers, they managed to reduce the number of parts in these handles from 34 to 5, which cut procurement costs by 40% and reduced the time need for installation from 12 seconds to 3 seconds.[16]

More generally, Toyota continues to refine its lean production system. For example, in die making, by 2004 Toyota had reduced the lead time to engineer and manufacture die sets for large body panels to 1.7 months, down from 3 months in 2002. By reducing lead time, Toyota reduced the startup costs associated with producing a new model, as well as the development time.[17]

In welding, Toyota developed and installed a simplified assembly process known as the "Global Body Line" or GBL. First developed in a low-volume, Vietnamese assembly plant in 1996, and introduced into its first Japanese plant in 1998, by 2004 the GBL was operating in some 20 of the company's 50 assembly plants and was found in all plants by 2007. The GBL system replaced Toyota's Flexible Body Line assembly philosophy that had been in place since 1985. The GBL system is based upon a series of programmable, robotic wielding tools. Under the old FBL system each car required three pallets to hold body parts in place during the welding process, each gripping either a major body side assembly or the roof assembly. The GBL system replaces these three pallets with a single pallet that holds all three major body panels in place from the inside as welding proceeds.[18]

According to Toyota, the GLB system has the following consequences:

- 30% reduction in the time a vehicle spends in the body shop
- 70% reduction in the time required to complete a major body change
- 50% cut in the cost to add or switch models
- 50% reduction in the investment to set up a line for a new model
- 50% reduction in assembly-line footprint

The floor space freed up by the GLB allows two assembly lines to be placed in the space traditionally required for one, effectively doubling plant capacity. Moreover, using GLB technology, as many as eight different models can be produced on a single assembly line. To achieve this, Toyota has pushed for consistency in design across model ranges, particularly with regard to the "hard points" that are grasped by the single master pallet.

Meanwhile, Toyota has been accelerating the process of moving toward fewer vehicle platforms, the goal being to build a wide range of models on a limited range of platforms that use many of the same component parts or modules. The company is reportedly working toward a goal of having just 10 platforms, down from over 20 in 2000.[19]

While Toyota is undoubtedly making progress refining its manufacturing efficiency, the fact remains that the productivity and quality gap between Toyota and its global competitors has narrowed. General Motors and Ford have both made significant strides in improving their quality and productivity in recent years. Moreover, in the American market at least, Toyota has suffered from the perception that its product offerings lack design flair and are not always as well attuned to consumer tastes as they might be. Here too, however, there are signs that Toyota is improving matters—interestingly enough, by listening more to its American designers and engineers.

A pivotal event in the changing relationship between Toyota and its American designers occurred in the late 1990s. Japanese managers had resisted their U.S. colleagues' idea that the company should produce a V8 pickup truck for the American market. To change their minds, the U.S. executives flew their Japanese counterparts over from Japan and took them to a Dallas Cowboys football game—with a pit stop in the Texas Stadium parking lot. There the Japanese saw row upon row of full-size pickups. Finally, it dawned on them that Americans see the pickup as more than a commercial vehicle, considering it primary transportation. The result of this was Toyota's best selling V8 pickup truck, the Tundra.[20]

American designers also pushed Toyota to redesign the Prius, its hybrid car first introduced in Japan in 1997. The Americans wanted a futuristic design change so that people would notice the technology. The result, the new Prius, became a surprise hit, with global sales of over 1 million vehicles by mid-2008.

By 2010, Toyota was manufacturing more than 1 million hybrid vehicles annually.[21]

Toyota's Americanization runs deeper than just product design issues. On the sales front, the company now sells more cars and trucks in North American than it does in Japan, and 70 to 80% of Toyota's global profits come from North America. On the personnel front, President Cho had made his reputation by opening Toyota's first U.S. production plant in Georgetown, Kentucky, in 1988. Another senior executive, Yoshi Inaba, spent 8 years in the United States and has an MBA from Northwestern University. Americans are also starting to make their way into Toyota's top ranks.[22]

Another concern of Toyota has been the aging of its customer base. According to J. D. Power, the average Toyota customer is 44 years old, compared with 38 for Volkswagen and 41 for Honda. Concerned that it was losing its cache with the younger generation, some 60 million of whom will reach driving age over the next few years, Toyota introduced a new car brand, the Scion, into America in June 2004. The Scion, targeted at young, entry-level buyers, could be purchased over the Web or through traditional Toyota dealers. Toyota's initial sales goals for the brand were 100,000 cars in 2005, but, in October 2004 it raised that target to 170,000. The average buyer in the months following launch was 31 years old.[23]

THE 2008–2009 CRISIS AND ITS AFTERMATH

Starting in mid-2008, sales in the global automobile industry collapsed at unprecedented rates, falling by around 40%. The sales collapse was a direct consequence of the global financial crisis that started in the American mortgage market, and then spilled over into other sectors. A combination of tight credit and uncertainty about the future caused consumers to buy far fewer new cars. For an industry with high fixed costs, a sales decline of this level was catastrophic.

Toyota was caught flat-footed by the decline. Toyota had been adding to its production capacity in the United States, its largest market, and pushing into the full-size pickup truck segment, when the storm hit. It had also been adding significant capacity elsewhere, a move that seemed sensible only 12 months earlier given that the company had been struggling to keep up with demand for its vehicles. Indeed, between 2001 and 2007, Toyota added about 500,000 cars' worth of production capacity per year, a pace that now seems to be aggressive.[24]

By April 2009, Toyota's sales in the United States were down 42% compared to the same month a year earlier. Moreover, there were sales declines in all other major national markets as well, including China, where Toyota sales fell by 17% in the first quarter of 2009, even though that market was one of the few that continued to grow. Toyota's problems in China reflected a slow response to increasing demand outside of China's big cities for small, affordable cars. Toyota exports from Japan were also hit hard by a rise in the value of the Japanese yen against the dollar and the euro during 2008 and early 2009.

In the United States, Toyota responded to the recession by placing the planned addition of a new production plant in Mississippi on hold and idling a production line in Texas. In Japan, production was cut by as much as 40% in some factories. These actions created a huge problem for Toyota, which adheres to a policy of lifetime employment and has not made significant workforce reductions since the 1950s. Toyota's initial response was to send underutilized employees to training sessions, and to have them work on identifying ideas for cost savings. However, the company did start to lay off temporary workers, and many questioned whether Toyota would be able to stick to its commitment of lifetime employment, particularly if the recession was prolonged.

Toyota also launched an "Emergency Profit Improvement Committee" tasked with finding $1.4 billion in savings in 2009. These cost savings came upon some $3.3 billion in cost reductions attained during the preceding few years. In typical Toyota style, no action seemed too small. Employees were been encouraged to take the stairs rather than use elevators to save electricity. The heat in factories was turned down. Teams of workers looked for ways to shave costs out of a production system that is already the world's most efficient.[25]

Trying to boost sales in the United States, Toyota introduced 0% financing in late 2008, but sales continued to falter. Ironically, one of Toyota's bestselling cars in the United States during much of 2007 and 2008, the fuel-efficient Prius, which carries a relative high price sticker, also saw steep sales declines in early 2009

as gasoline prices fell. Consumers who did purchase switched to low-priced, small cars from Kia and Ford.

Meanwhile, Toyota was changing its senior management ranks. In June 2009, Akio Toyoda, grandson of the company's founder, succeeded outgoing CEO Katsuaki Watanabe. With an MBS from Babson College in the United States, and time working in both New York and London, Toyoda is without question the most cosmopolitan CEO to take the helm at Toyota. He did so at a particularly challenging time for the company. His major challenge was to weather the storm and return the company to its growth path.

By 2012, it looked as if he had succeeded. Toyota had regained the mantel of the world's largest automobile company. Its reputation for quality, which had been badly tarnished by the sudden-acceleration problems in the United States, was again riding high. Accordingly to J. D. Power's annual Vehicle Dependency Study, after slipping in 2009 and 2010, Toyota brands regained the top spot in 2011 and 2012. That being said, Toyota faced invigorated competitors who were fast closing in on the company. Most notably, Hyundai-Kia of South Korea had grown its output from just 2.4 million units in 2000 to 7.1 million in 2012, making it the fourth-largest automaker in the world. Hyundai was more profitable than Toyota and produced more vehicles per employee, suggesting that Toyota might be losing its crown as the most productive automobile company in the world. In addition, Volkswagen was investing aggressively in capacity, particularly in China—now the world's largest national automobile market—and was well positioned to challenge Toyota for global market-share leadership. Rounding out the top four global automakers was General Motors, which had emerged from bankruptcy a smaller but stronger company. Indeed, on global measures of labor productivity, GM surpassed Toyota. Moreover, GM was well positioned in the large and rapidly growing Chinese market, where Toyota had struggled due to anti-Japanese sentiment. The future thus presented numerous challenges for Toyota.[26]

NOTES

1. This section is based primarily on the account given in M. A. Cusumano, *The Japanese Automobile Industry* (Cambridge, Mass: Harvard University Press, 1989).
2. The material in this section is drawn from three main sources: M. A. Cusumano, *The Japanese Automobile Industry* (Cambridge, Mass.: Harvard University Press, 1989); Taiichi Ohno, *Toyota Production System* (Cambridge, Mass.: Productivity Press, 1990; Japanese Edition, 1978); J. P. Womack, D. T. Jones, and D. Roos, *The Machine That Changed the World* (New York: Macmillan,1990).
3. The material in this section is based on M. A. Cusumano, *The Japanese Automobile Industry*.
4. N. Powell, "U.S.-Japanese Joint Venture: New United Motor Manufacturing, Inc.," *Planning Review*, January–February 1989, pp. 40–45.
5. J. P. Womack, D. T. Jones, and D. Roos, *The Machine That Changed the World*.
6. J. B. Treece, "Just What Detroit Needs: 200,000 More Toyotas a Year," *Businessweek*, December 10, 1990, p. 29.
7. P. Eisensteon, "Toyota Investing Over $500 Million to Launch US Lexus Production," *NBC News*, April 19, 2013.
8. P. Strozniak, "Toyota Alters the Face of Production," *Industry Week*, August 13, 2001, pp. 46–48.
9. Anonymous, "The Car Company Out in Front," *The Economist*, January 29, 2005, pp. 65–67.
10. R. Newman, "How Toyota Could Become the US Sales Champ," *US News and World Reports*, June 9, 2008.
11. J. D. Power press release, "Lexus Ranks Highest in Vehicle Dependability for 14th Consecutive Year," August 7, 2008; J. D. Power press release, "Overall Initial Quality Improves Considerably," June 4, 2008.
12. J. D. Power press release, "Toyota Ranks Highest in Japan's First Long Term Vehicle Dependability Study," September 2, 2004.
13. *Oliver Wyman's Harbour Report*, Oliver Wyman, June 2008.
14. Ibid.
15. Ibid.
16. B. Bremner and C. Dawson, "Can Anything Stop Toyota?" *Businessweek*, November 17, 2003, pp. 114–117.
17. M. Hara, "Moving Target," *Automotive Industries*, June 2004, pp. 26–29.
18. B. Visnic, "Toyota Adopts New Flexible Assembly Process," *Wards Auto World*, November