

## Chapter 2

# How Toyota Became the World's Best Manufacturer: The Story of the Toyoda Family and the Toyota Production System

*I plan to cut down on the slack time within work processes and in the shipping of parts and materials as much as possible. As the basic principle in realizing this plan, I will uphold the "just in time" approach. The guiding rule is not to have goods shipped too early or too late."*<sup>1</sup>

—Kiichiro Toyoda, founder of Toyota Motor Company, 1938

The most visible product of Toyota's quest for excellence is its manufacturing philosophy, called the Toyota Production System (TPS). TPS is the next major evolution in efficient business processes after the mass production system invented by Henry Ford, and it has been documented, analyzed, and exported to companies across industries throughout the world. Outside of Toyota, TPS is often known as "lean" or "lean production," since these were the terms made popular in two best-selling books, *The Machine That Changed the World* (Womack, Jones, Roos, 1991) and *Lean Thinking* (Womack, Jones, 1996). The authors make it clear, however, that the foundation of their research on lean is TPS and Toyota's development of it.

Although Toyota now has over 240,000 employees around the world, in many ways it is still a large "family business" with considerable influence still exercised by the founding Toyoda family. In order to understand TPS and the Toyota Way, and how the company became the world's best manufacturer, it is helpful to first understand the history and personalities of the founding family members, who left an indelible mark on the Toyota culture. What is most important about this is not the fact that one family has control, (Ford is similar in this respect), but the remarkable consistency of leadership and philosophy throughout the history

of Toyota. The roots of all of the Toyota Way principles can be traced back to the very beginnings of the company. And the “DNA” of the Toyota Way is encoded in each and every Toyota leader whether a Toyoda family member or not.

## The Toyoda Family: Generations of Consistent Leadership

The story begins with Sakichi Toyoda, a tinkerer and inventor, not unlike Henry Ford, who grew up in the late 1800s in a remote farming community outside of Nagoya. At that time, weaving was a major industry and the Japanese government, wishing to promote the development of small businesses, encouraged the creation of cottage industries spread across Japan. Small shops and mills employing a handful of people was the norm. Housewives made a little spending money by working in these shops or at home. As a boy, Toyoda learned carpentry from his father and eventually applied that skill to designing and building wooden spinning machines. In 1894 he began to make manual looms that were cheaper but worked better than existing looms.

Toyoda was pleased with his looms, but disturbed that his mother, grandmother, and their friends still had to work so hard spinning and weaving. He wanted to find a way to relieve them of this punishing labor, so he set out to develop power-driven wooden looms.

This was an age when inventors had to do everything themselves. There were no large R&D departments to delegate work to. When Toyoda first developed the power loom, there was no available power to run the loom, so he turned his attention to the problem of generating power. Steam engines were the most common source of power, so he bought a used steam engine and experimented with running the looms from this source. He figured out how to make this work by trial and error and getting his hands dirty—an approach that would become part of the foundation of the Toyota Way, *genchi genbutsu*. In 1926, He started Toyoda Automatic Loom Works, the parent firm of the Toyota Group and still a central player in the Toyota conglomerate (or *keiretsu*) today.

Toyoda’s endless tinkering and inventing eventually resulted in sophisticated automatic power looms that became “as famous as Mikimoto pearls and Suzuki violins” (Toyoda, 1987). Among his inventions was a special mechanism to automatically stop a loom whenever a thread broke—an invention that evolved into a broader system that became one of the two pillars of the Toyota Production System, called *jidoka* (automation with a human touch). Essentially, *jidoka* means building in quality as you produce the material or “mistake proofing.” It also refers to designing operations and equipment so your workers are not tied to machines and are free to perform value-added work.

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Throughout his life, Sakichi Toyoda was a great engineer and later referred to as Japan's "King of Inventors." However, his broader contribution to the development of Toyota was his philosophy and approach to his work, based on a zeal for continuous improvement. Interestingly, this philosophy, and ultimately the Toyota Way, was significantly influenced by his reading of a book first published in England in 1859 by Samuel Smiles entitled *Self-Help* (Smiles, 2002). It preaches the virtues of industry, thrift, and self-improvement, illustrated with stories of great inventors like James Watt, who helped develop the steam engine. The book so inspired Sakichi Toyoda that a copy of it is on display under glass in a museum set up at his birth site.

As I read Samuel Smiles' book, I could see how it influenced Toyoda. First of all, Smiles' inspiration for writing the book was philanthropic. It grew out of his efforts to help young men in difficult economic circumstances who were focused on improving themselves—Smiles' goal was not to make money. Second, the book chronicles inventors whose natural drive and inquisitiveness led to great inventions that changed the course of humanity. For example, Smiles concludes that the success and impact of James Watt did not come from natural endowment but rather through hard work, perseverance, and discipline. These are exactly the traits displayed by Sakichi Toyoda in making his power looms work with steam engines. There are many examples throughout Smiles' book of "management by facts" and the importance of getting people to pay attention actively—a hallmark of Toyota's approach to problem solving based on *genchi genbutsu*.

### The Toyota Automotive Company

*His "mistake-proof" loom became Toyoda's most popular model, and in 1929 he sent his son, Kiichiro, to England to negotiate the sale of the patent rights to Platt Brothers, the premier maker of spinning and weaving equipment. His son negotiated a price of 100,000 English pounds, and in 1930 he used that capital to start building the Toyota Motor Corporation (Fujimoto, 1999).*

It is perhaps ironic that the founder of Toyota Motor Company, Kiichiro Toyoda, was a frail and sickly boy, who many felt did not have the physical capacity to become a leader. But his father disagreed and Kiichiro Toyoda persevered. When Sakichi Toyoda tasked his son with building the car business, it was not to increase the family fortune. He could just as well have handed over to him the family loom business. Sakichi Toyoda was undoubtedly aware that the world was changing and power looms would become yesterday's technology while automobiles were tomorrow's technology. But more than this, he had put his mark on the industrial world through loom making and wanted his son to have his opportunity to contribute to the world. He explained to Kiichiro:

*Everyone should tackle some great project at least once in their life. I devoted most of my life to inventing new kinds of looms. Now it is your turn. You should make an effort to complete something that will benefit society. (Reingold, 1999)*

Kiichiro's father sent him to the prestigious Tokyo Imperial University to study mechanical engineering; he focused on engine technology. He was able to draw on the wealth of knowledge within Toyoda Automatic Loom Works on casting and machining metal parts. Despite his formal engineering education, he followed in his father's footsteps of learning by doing. Shoichiro Toyoda, his son, described Kiichiro Toyoda as a "genuine engineer" who:

*... gave genuine thought to an issue rather than rely on intuition. He always liked to accumulate facts. Before he made the decision to make an automobile engine he made a small engine. The cylinder block was the most difficult thing to cast, so he gained a lot of experience in that area and, based on the confidence he then had, he went ahead. (Reingold, 1999)*

His approach to learning and creating mirrored that of his father. After World War II, Kiichiro Toyoda wrote, "I would have grave reservations about our ability to rebuild Japan's industry if our engineers were the type who could sit down to take their meals without ever having to wash their hands."

He built Toyota Automotive Company on his father's philosophy and management approach, but added his own innovations. For example, while Sakichi Toyoda was the father of what would become the *jidoka* pillar of the Toyota Production System, Just-In-Time was Kiichiro Toyoda's contribution. His ideas were influenced by a study trip to Ford's plants in Michigan to see the automobile industry as well as seeing the U.S. supermarket system of replacing products on the shelves just in time as customers purchased them. As discussed in Chapter 11, his vision was at the root of the *kanban* system, which is modeled after the supermarket system. Notwithstanding these achievements, it was his actions as a leader, like his father, that left the largest imprint on Toyota.

Along the way to building a car company World War II happened, Japan lost, and the American victors could have halted car production. Kiichiro Toyoda was very concerned that the post-war occupation would shut down his company. On the contrary, the Americans realized the need for trucks in order to rebuild Japan and even helped Toyota to start building trucks again.

As the economy revitalized under the occupation, Toyota had little difficulty getting orders for automobiles, but rampant inflation made money worthless and getting paid by customers was very difficult. Cash flow became so horrendous that at one point in 1948 Toyota's debt was eight times its total capital value (Reingold, 1999). To avoid bankruptcy, Toyota adopted strict cost-cutting policies, including

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voluntary pay cuts by managers and a 10 percent cut in pay for all employees. This was part of a negotiation with employees in lieu of layoffs, to maintain Kiichiro Toyoda's policy against firing employees. Finally, even the pay cuts were not enough. This forced him to ask for 1,600 workers to "retire" voluntarily. This led to work stoppages and public demonstrations by workers, which at the time were becoming commonplace across Japan.

Companies go out of business every day. The usual story we hear these days is of the CEO hanging on and fighting to salvage his or her sweetheart option packages or perhaps selling off the company to be broken up for any valuable assets. It is always some other person's fault that the company has failed. Kiichiro Toyoda took a different approach. He accepted responsibility for the failing of the automobile company and resigned as president, even though in reality the problems were well beyond his or anyone else's control. His personal sacrifice helped to quell worker dissatisfaction. More workers voluntarily left the company and labor peace was restored. However, his tremendous personal sacrifice had a more profound impact on the history of Toyota. Everyone in Toyota knew what he did and why. The philosophy of Toyota to this day is to think beyond individual concerns to the long-term good of the company, as well as to take responsibility for problems. Kiichiro Toyoda was leading by example in a way that is unfathomable to most of us.

Toyoda family members grew up with similar philosophies. They all learned to get their hands dirty, learned the spirit of innovation, and understood the values of the company in contributing to society. Moreover, they all had the vision of creating a special company with a long-term future. After Kiichiro Toyoda, one of the Toyoda family leaders who shaped the company was Eiji Toyoda, the nephew of Sakichi and younger cousin of Kiichiro. Eiji Toyoda also studied mechanical engineering, entering Tokyo Imperial University in 1933. When he graduated, his cousin Kiichiro gave him the assignment of setting up, all by himself, a research lab in a "car hotel" in Shibaura (Toyoda, 1987).

By "car hotel," Kiichiro was referring to the equivalent of a large parking garage. These were jointly owned by Toyota and other firms, and were necessary to encourage car ownership among the small number of wealthy individuals who could afford cars. Eiji Toyoda started by cleaning a room in one corner of the building himself and getting some basic furniture and drafting boards. He worked alone for a while and it took one year to finally build a group of about 10 people. His first task was to research machine tools, which he knew nothing about. He also checked defective cars, as one role of the car hotel was to service Toyota products. In his spare time, he would check out companies that could make auto parts for Toyota. He also had to find reliable parts suppliers in the Tokyo area in time for the completion of a Toyota plant.

So Eiji Toyoda, like his cousin and uncle, grew up believing that the only way

to get things done was to do it yourself and get your hands dirty. When a challenge arose, the answer was to try things—to learn by doing. With this system of beliefs and values, it would be unimaginable to hand over the company to a son, cousin, or nephew who did not get his hands dirty and truly love the automobile business. The company values shaped the development and selection of each generation of leaders.

Eventually Eiji Toyoda became the president and then chairman of Toyota Motor Manufacturing. He helped lead and then presided over the company during its most vital years of growth after the war and through its growth into a global powerhouse. Eiji Toyoda played a key role in selecting and empowering the leaders who shaped sales, manufacturing, and product development, and, most importantly, the Toyota Production System.

Now the Toyota Way has been spread beyond the leaders in Japan to Toyota associates around the world. But since today's leaders did not go through the growing pains of starting a company from scratch, Toyota is always thinking about how to teach and reinforce the value system that drove the company founders to get their hands dirty, to truly innovate and think deeply about problems based on actual facts. This is the legacy of the Toyoda family.

## The Development of the Toyota Production System (TPS)<sup>2</sup>

Toyota Motor Corporation struggled through the 1930s, primarily making simple trucks. In the early years, the company produced poor-quality vehicles with primitive technology (e.g., hammering body panels over logs) and had little success. In the 1930s, Toyota's leaders visited Ford and GM to study their assembly lines and carefully read Henry Ford's book, *Today and Tomorrow* (1926). They tested the conveyor system, precision machine tools, and the economies of scale idea in their loom production. Even before WWII, Toyota realized that the Japanese market was too small and demand too fragmented to support the high production volumes in the U.S. (A U.S. auto line might produce 9,000 units per month, while Toyota would produce only about 900 units per month, and Ford was about 10 times as productive.) Toyota managers knew that if they were to survive in the long run they would have to adapt the mass production approach for the Japanese market. But how?

Now jump ahead to Toyota's situation after World War II, in 1950. It had a budding automotive business. The country had been decimated by two atom bombs, most industries had been destroyed, the supply base was nil, and consumers had little money. Imagine being the plant manager, Taiichi Ohno. Your boss, Eiji Toyoda, has returned from another tour of U.S. plants, including the

Ford's River Rouge complex, and he calls you into his office. He calmly hands you a new assignment. (Don't all bosses come back from trips with assignments?) The assignment is to improve Toyota's manufacturing process so that it equals the productivity of Ford. It makes you wonder what Toyoda could have been thinking. Based on the mass production paradigm of the day, economies of scale alone should have made this an impossible feat for tiny Toyota. This was David trying to take on Goliath.

Ford's mass production system was designed to make huge quantities of a limited number of models. This is why all Model T's were originally black. In contrast, Toyota needed to churn out low volumes of different models using the same assembly line, because consumer demand in their auto market was too low to support dedicated assembly lines for one vehicle. Ford had tons of cash and a large U.S. and international market. Toyota had no cash and operated in a small country. With few resources and capital, Toyota needed to turn cash around quickly (from receiving the order to getting paid). Ford had a complete supply system, Toyota did not. Toyota didn't have the luxury of taking cover under high volume and economies of scale afforded by Ford's mass production system. It needed to adapt Ford's manufacturing process to achieve simultaneously high quality, low cost, short lead times, and flexibility.

### **One-Piece Flow, a Core Principle**

When Eiji Toyoda and his managers took their 12-week study tour of U.S. plants in 1950, they were expecting to be dazzled by their manufacturing progress. Instead they were surprised that the development of mass production techniques hadn't changed much since the 1930s. In fact, the production system had many inherent flaws. What they saw was lots of equipment making large amounts of products that were stored in inventory, only to be later moved to another department where big equipment processed the product, and so on to the next step. They saw how these discrete process steps were based on large volumes, with interruptions between these steps causing large amounts of material to sit in inventory and wait. They saw the high cost of the equipment and its so-called efficiency in reducing the cost per piece, with workers keeping busy by keeping the equipment busy. They looked at traditional accounting measures that rewarded managers who cranked out lots of parts and kept machines and workers busy, resulting in a lot of overproduction and a very uneven flow, with defects hidden in these large batches that could go undiscovered for weeks. Entire workplaces were disorganized and out of control. With big forklift trucks moving mountains of materials everywhere, the factories often looked more like warehouses. To say the least, they were not impressed. In fact, they saw an opportunity to catch up.

Fortunately for Ohno, his assignment from Eiji Toyoda to “catch up with Ford’s productivity” didn’t mean competing head-on with Ford. He just had to focus on improving Toyota’s manufacturing within the protected Japanese market—a daunting assignment nonetheless. So Ohno did what any good manager would have done in his situation: he benchmarked the competition through further visits to the U.S. He also studied Ford’s book, *Today and Tomorrow*. After all, one of the major components that Ohno believed Toyota needed to master was continuous flow and the best example of that at the time was Ford’s moving assembly line. Henry Ford had broken the tradition of craft production by devising a new mass production paradigm to fill the needs of the early 20th century. A key enabler of mass production’s success was the development of precision machine tools and interchangeable parts (Womack, Jones, Roos, 1991). Using principles from the scientific management movement pioneered by Frederick Taylor, Ford also relied heavily on time studies, very specialized tasks for workers, and a separation between the planning done by engineers and the work performed by workers.

In his book Ford also preached the importance of creating continuous material flow throughout the manufacturing process, standardizing processes, and eliminating waste. But while he preached it, his company didn’t always practice it. His company turned out millions of black Model T’s and later Model A’s using wasteful batch production methods that built up huge banks of work-in-process inventory throughout the value chain, pushing product onto the next stage of production (Womack, Jones, Roos, 1991). Toyota saw this as an inherent flaw in Ford’s mass production system. Toyota did not have the luxury of creating waste, it lacked warehouse and factory space and money, and it didn’t produce large volumes of just one type of vehicle. But it determined it could use Ford’s original idea of continuous material flow (as illustrated by the assembly line) to develop a system of one-piece flow that flexibly changed according to customer demand and was efficient at the same time. Flexibility required marshaling the ingenuity of the workers to continually improve processes.

## Creating the Manufacturing System That Changed the World

In the 1950s, Ohno returned to the place he understood best, the shop floor, and went to work to change the rules of the game. He did not have a big consulting firm, Post-it® notes, or PowerPoint to reinvent his business processes. He could not install an ERP system or use the Internet to make information move at the speed of light. But he was armed with his shop-floor knowledge, dedicated engineers, managers, and workers who would give their all to help the company succeed. With this he began his many “hands-on” journeys through Toyota’s few

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factories, applying the principles of *jidoka* and one-piece flow. Over years and then decades of practice, he had come up with the new Toyota Production System.<sup>3</sup> Of course, Ohno and his team did not do this alone.

Along with the lessons of Henry Ford, TPS borrowed many of its ideas from the U.S. One very important idea was the concept of the “pull system,” which was inspired by American supermarkets. In any well-run supermarket, individual items are replenished as each item begins to run low on the shelf. That is, material replenishment is initiated by consumption. Applied to a shop floor, it means that Step 1 in a process shouldn't make (replenish) its parts until the next process after it (Step 2) uses up its original supply of parts from Step 1 (that is down to a small amount of “safety stock”). In TPS, when Step 2 is down to a small amount of safety stock, this triggers a signal to Step 1 asking it for more parts.

This is similar to what happens when you fill the gas tank in your car. As in “Step 2,” your car signals a need for more fuel when the gauge tells you that fuel is low. Then you go to the gas station, Step 1, to refill. It would be foolish to fill your gas tank when you're not low on gas, but the equivalent of this—overproduction—happens all the time in mass production. At Toyota every step of every manufacturing process has the equivalent of a “gas gauge” built in, (called *kanban*), to signal to the previous step when its parts need to be replenished. This creates “pull” which continues cascading backwards to the beginning of the manufacturing cycle. In contrast, most businesses use processes that are filled with waste, because work in Step 1 is performed in large batches before it is needed by Step 2. This “work in process” must then be stored and tracked and maintained until needed by step 2—a waste of many resources. Without this pull system, just-in-time (JIT), one of the two pillars of TPS (the other is *jidoka*, built-in quality), would never have evolved.

JIT is a set of principles, tools, and techniques that allows a company to produce and deliver products in small quantities, with short lead times, to meet specific customer needs. Simply put, JIT delivers the right items at the right time in the right amounts. The power of JIT is that it allows you to be responsive to the day-by-day shifts in customer demand, which was exactly what Toyota needed all along.

Toyota also took to heart the teachings of the American quality pioneer, W. Edwards Deming. He gave U.S. quality and productivity seminars in Japan and taught that, in a typical business system, meeting and exceeding the customers' requirements is the task of everyone within an organization. And he dramatically broadened the definition of “customer” to include both internal and external customers. Each person or step in a production line or business process was to be treated as a “customer” and to be supplied with exactly what was needed, at the exact time needed. This was the origin of Deming's principle, “the next process is the customer.” The Japanese phrase for this, *atokotei wa o-kyakusama*, became one

of the most significant expressions in JIT, because in a pull system it means *the preceding process must always do what the subsequent process says*. Otherwise JIT won't work.

Deming also encouraged the Japanese to adopt a systematic approach to problem solving, which later became known as the Deming Cycle or Plan-Do-Check-Act (PDCA) Cycle, a cornerstone of continuous improvement. The Japanese term for continuous improvement is *kaizen* and is the process of making incremental improvements, no matter how small, and achieving the lean goal of eliminating all waste that adds cost without adding to value.<sup>4</sup> *Kaizen* teaches individuals skills for working effectively in small groups, solving problems, documenting and improving processes, collecting and analyzing data, and self-managing within a peer group. It pushes the decision making (or proposal making) down to the workers and requires open discussion and a group consensus before implementing any decisions. *Kaizen* is a total philosophy that strives for perfection and sustains TPS on a daily basis.

When Ohno and his team emerged from the shop floor with a new manufacturing system, it wasn't just for one company in a particular market and culture. What they had created was a new paradigm in manufacturing or service delivery—a new way of seeing, understanding, and interpreting what is happening in a production process, that could propel them beyond the mass production system.

By the 1960s, TPS was a powerful philosophy that all types of businesses and processes could learn to use, but this would take a while. Toyota did take the first steps to spread “lean” by diligently teaching the principles of TPS to their key suppliers. This moved its isolated lean manufacturing plants toward a total lean extended enterprise—when everyone in the supply chain is practicing the same TPS principles. A powerful business model indeed! Still, the power of TPS was mostly unknown outside of Toyota and its affiliated suppliers until the first oil shock of 1973 that sent the world into a global recession, with Japan among the hardest hit. Japanese industry went into a tailspin and the name of the game was survival. But the Japanese government began to notice when Toyota went into the red for less time than other companies and came back to profitability faster. The Japanese government took the initiative to launch seminars on TPS, even though it understood only a fraction of what made Toyota tick.

In the early '80s when I visited Japan, it was my experience that as you moved out of Toyota City and Toyota's group of affiliates to other Japanese companies, the application of TPS principles quickly became watered down and weakened. It would still be a while before the world would understand the Toyota Way and the new paradigm of manufacturing.

Part of the problem was that mass production after World War II focused on cost, cost, cost. “Make bigger machines and through economies of scale drive

down cost.” “Automate to replace people if it can be cost justified.” This kind of thinking ruled the manufacturing world until the 1980s. Then the business world got the quality religion from Deming, Joseph Juran, Kaoru Ishikawa, and other quality gurus. It learned that focusing on quality actually reduced cost more than focusing only on cost. Finally, in the 1990s, through the work of MIT's Auto Industry Program and the bestseller based on its research, *The Machine That Changed the World* (Womack, Jones, Roos, 1991), the world manufacturing community discovered “lean production”—the authors' term for what Toyota had learned decades earlier through focusing on speed in the supply chain: *shortening lead time by eliminating waste in each step of a process leads to best quality and lowest cost, while improving safety and morale.*

## Conclusion

Toyota started with the values and ideals of the Toyoda family. To understand the Toyota Way, we must start with the Toyoda family. They were innovators, they were pragmatic idealists, they learned by doing, and they always believed in the mission of contributing to society. They were relentless in achieving their goals. Most importantly, they were leaders who led by example.

TPS evolved to meet the particular challenges Toyota faced as it grew as a company. It evolved as Taiichi Ohno and his contemporaries put these principles to work on the shop floor through years of trial and error. When we take a snapshot of this at a point in time, we can describe the technical features and accomplishments of TPS. But the way that Toyota developed TPS and the challenges it faced and the approach it took to solving these problems is really a reflection of the Toyota Way. Toyota's own internal Toyota Way document talks about the “spirit of challenge” and the acceptance of responsibility to meet that challenge. The document states:

*We accept challenges with a creative spirit and the courage to realize our own dreams without losing drive or energy. We approach our work vigorously, with optimism and a sincere belief in the value of our contribution.*

And further:

*We strive to decide our own fate. We act with self-reliance, trusting in our own abilities. We accept responsibility for our conduct and for maintaining and improving the skills that enable us to produce added value.*

These powerful words describe well what Ohno and the team accomplished. Out of the rubble of WWII they accepted a seemingly impossible challenge—match Ford's productivity. Ohno accepted the challenge and, “with a creative spirit and courage,” solved problem after problem and evolved a new production sys-

tem. He and the team did it themselves and did not look to be bailed out by the Japanese government or any third party. This same process has been played out time and time again throughout the history of Toyota.

## Notes

1. From a speech given at the completion of the Toyota Koromo plant.
2. A succinct and informative discussion of the history of the Toyota Production System is provided in Takahiro Fujimoto's book, *The Evolution of a Manufacturing System at Toyota* (New York: Oxford University Press, 1999). Some of the facts in this section are based on that book.
3. Still one of the best and surprisingly readable overviews of the Toyota Production System is Taiichi Ohno's own book, *Toyota Production System: Beyond Large-Scale Production* (Portland, OR: Productivity Press, 1988). Ohno gives a very personalized account of the system in a story fashion.
4. Actually kaizen means "change for the better" and can refer to very large changes or small, incremental changes. Because Western firms tend to focus on breakthrough innovation and are weak at continuously improving in small amounts, this has been the focus of teaching kaizen to Western firms. Sometime kaikaiku is used to refer to major, revolutionary changes.