Toyota and Why It Is So Successful

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1. Introduction

The purpose of this paper is to describe one of the most successful companies in the world and explain the reasons for that success. Fortune magazine's February 20, 2006 edition featured this headline on its cover: "The Tragedy of General Motors" and a story of GM's woes by Carol J. Loomis. Two weeks later, Fortune's next edition on March 6, 2006 had this headline on its cover: "How Toyota Does It: The Triumph of the Prius." This stark contrast is typical of the stories circulating in the media these days. At a time when a company that was once admired and for many years held the lofty position of the world biggest automaker appears on the brink of bankruptcy[1)], Toyota is about to overtake it in global sales this year (O'Dell, 2005). Why is Toyota continuing to thrive at a time when other carmakers are struggling to survive?

At the outset I would like to acknowledge the main source for much of the information in this paper: *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer* by Jeffrey K. Liker (2004).

This paper is organized as follows:

1. Introduction
2. The history of Toyota
3. The Toyota Way
4. Summary and conclusion

1) As of May 2006 GM was still struggling to stay out of bankruptcy.

2. The History of Toyota

For organizational convenience I will discuss Toyota history as follows:

- The start
- The 1940s
- The 1950s
- Etc.

The start. The Toyota Motor Corp. (TMC) had its beginning in 1933 when it was established as a division within the Toyoda Automatic Loom Works, Ltd. The founder of Toyota was Kiichiro Toyoda (1894–1952), the son of Sakichi Toyoda (1867–1930). The values that have underpinned Toyota success started with Sakichi who was the son of a carpenter. According to Liker (2004) he was greatly influenced by Samuel Smiles book *Self-Help* first published in 1859 (p. 17). This book focused on inventors and how their success was mostly due to hard work and persistence. Sakichi went from carpentry, which he had learned from his father, to making looms for weaving. He then came up with many inventions that resulted in remarkable improvements in looms. For example, by 1924 he had developed the famous "Type G" automatic loom, but not without much of that "hard work and persistence." One of the important features of Toyoda's looms was a device that would automatically stop the loom should a thread break. This prevented any defective cloth from being produced. This concept of building into a machine features that prevent poor quality is know as *jidoka* and would become one of the TMC's two "pillars" of the Toyota Production System (TPS).[2] According to Wikipedia (Sakichi Toyoda, 2006) Sakichi is often referred to as the "King of Japanese Inventors" and as the "father of the Japanese industrial revolution."

2) The other is just-in-time.

In 1926 Sakichi started the Toyoda Automatic Loom Works that, due to the superiority of the Toyoda looms, became highly successful. Even today, Toyota produces highly praised spinning and weaving machines. However, to Sakichi's credit he recognized that more than weaving machines, the automobile was the wave of the future. Therefore he encouraged his son, Kiichiro to get into the automobile business. Drawing on the resources of the Toyoda loom business, in 1930, Kiichiro began doing research into small gasoline-powered engines (History of Toyota [HOT], 2006) and, as mentioned, an automobile division was established within the Toyoda loom works in 1933. But it wasn't just to increase the Toyoda fortunes that caused the elder Toyoda to encourage his son. As quoted in Liker (2004, p. 18) from Reingold (1999), this is what Sakichi told 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.

Which exemplifies another part of the Toyota philosophy[3)]: that a company should always do what it can to better society.

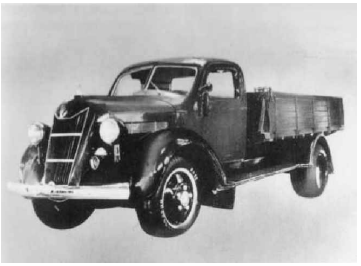
According to Liker, there was a lot of hard learning for Toyota in those early years:

> 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. (p. 20)

But, with persistence in 1935 Toyota came out with its first prototype car, the A1. According the Stephenson (2006): "Its body was a copy of the Chrysler Airflow, the 3389cc engine was copied from a Chevrolet and the chassis was copied

3) Besides hard work and persistence.

from a Ford.[4]" That same year production of the G1 truck began. According to Stephenson:



G1 Truck

> Early units broke down a lot, so customers were carefully chosen for loyalty. Aftermarket sale support was so strong that entire trucks were often replaced without question. Development and production engineers were loaned to dealers so that repairs could be done and so that the engineers could learn about what needed to be changed in production.

And, in 1936 Toyota came out with its first production car, the Model AA Sedan.

Model AA Sedan

In 1937 the Toyota Motor Co (TMC)[5] was established as an independent company. One year later the first TMC plant started operations and the just-in-time system was launched on a full-scale basis (HOT). This plant (Honsha), near Toyota's head office in Aichi Prefecture (near Nagoya), is still operating making Land Cruisers (Toyota Company Profile [TCP], 2005).

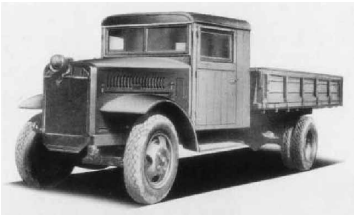
The 1940s. This was a time of dramatic change for Toyota. It was expanding rapidly trying to meet the demands of WWII and later the consumer market.

4) According to this homepage, this was intentional to provide a source of interchangeable parts.

5) According to Wikipedia (Toyota Motor Corporation [TMC]) the name was changed from Toyoda to Toyota for three reasons: (1) to differentiate the founders' work from his personal life, (2) ease of pronunciation, and (3) to give the company a happy beginning as "Toyota" has eight strokes in *katakana* (トヨタ) and eight is considered a lucky number in Japan.

According to Wikipedia (Toyota Motor Corporation [TMC]):

> During the Pacific War the company was dedicated to truck production for the Imperial Army. Because of severe shortages in Japan, military trucks were kept as simple as possible. For example, the trucks had only one headlight on the center of the hood. Fortunately for Toyota, the war ended shortly before a scheduled allied bombing run on the Toyota factories in Aichi.



WWII truck with one headlight

Following the war, production returned to the needs of the consumer with the introduction of the SB small truck and the SA compact passenger car in 1947. That same year Toyota celebrated the production of its 100,000th vehicle (HOT). During this decade Toyota established several supporting firms as shown in Appendix A.

The 1950s. The 1950s were again a time of remarkable change for Toyota. Two people now take on prominent roles in Toyota's development: Eiji Toyoda and Taiichi Ohno. In a way one can say their contributions were "just-in-time." Towards the end of the 1940s Toyota was experiencing a severe cash flow problem. In trying to stave off bankruptcy, it called for strict cost cutting and a request for "voluntary" retirements. This led to a labor dispute that was only quelled when the president, Kiichiro, accepted responsibility and resigned. This personal sacrifice on the part of Kiichiro reflects one of the foundational elements of Toyota's philosophy. As Liker puts it:

> 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… (p. 19)

At this same time when Toyota was near collapse Eiji Toyoda and Taiichi

Ohno were busy devising ways that the company could better compete with its American counterparts, Ford and GM. Towards this end Eiji, who had been given a leading role in the company, visited U.S. plants to learn the secret of their success. What he found was both good and bad: the good was the continuous flow system of the assembly line, the bad was the batch and queue system of making parts. Large companies like Ford and GM could afford to make a lot of one part at one time and have huge inventories of it sitting around to be used, Toyota didn't have that luxury. This led Eiji and Taiichi Ohno (a production genius) to continue perfecting the just-in-time system with the idea of not making and delivering a part to the assembly line until it is called for; in other words, a "pull" system.

According to Liker (2004) about this time Toyota began applying some of W. Edwards Deming's[6] ideas such as everyone being responsible for meeting the customer's expectations, the idea of an internal customer, the PDCA cycle[7], and *kaizen* (continual incremental improvement). In fact, in 1965, Toyota won Japan's top quality award named after Deming.

As these ideas were adopted and put into practice, the now famous Toyota Production System (TPS) gradually emerged.

> 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"[8] by diligently teaching the principles of

6) Deming (1900–1993) is considered one of the most influential members in the quality movement and is famous for his Fourteen Points (see Appendix B). For a brief history of Deming see Austenfeld (2001).

7) Also known as the Deming cycle, the Plan, Do, Check, Act (PDCA) cycle is a way of approaching almost any task: based on "customer" expectations, *plan* the task, then *do* it, then *check* to see how well the results conform to what the customer wanted, finally *act* to improve the results.

8) A generic name for the TPS.

TPS to their key suppliers. (Liker, 2004, p. 24)

The 1950s saw Toyota, despite its earlier difficulties, continue to come out with new models of cars and trucks such as the famous Crown introduced in 1955. In fact by 1955 Toyota was making 8,400 cars per year and 600,000 cars per year by 1965 (Toyota Corporate History [TCH]).

Some other notable events that took place during the 1950s were (HOT):

- 1951: The creative idea suggestion system was started.
- 1953: The corporate slogan "Good Thinking, Good Products" was established.
- 1957: Toyota Motor Sales, U.S.A. Inc. was established.
- 1958: Toyota opens a plant in Brazil (its first outside of Japan).
- 1959: Toyota's second Japanese plant starts operations (Motomachi).

The 1960s. This decade was one of explosive growth for Toyota. By 1962 Toyota had produced its one-millionth vehicle domestically. It was a time of expanding exports too with cumulative exports also reaching the one million mark by 1969 (HOT).

In 1961 Toyota announced what it hoped would be car for everyone much like the original Volkswagen. The Publica—for "Public Car"—was small, cheap, economical, *and plain*. It fact it proved too plain for a Japanese public that was moving upscale faster than Toyota realized. So Toyota, in typically fashion, reacted to give the customer what he or she wanted, the famous Corolla. As Stephenson (2005) describes it (under "Corolla Production Data"):

> Japan's growing middle class thought the Publica (Toyota's entry level car in the early 1960's) was too boring while the Crown and Corona were too expensive for them. At this

1966 Toyota Corolla

> time, a Toyota engineer called Tatsuo Hasegawa had noticed that the Opel Kadett was doing very well in Germany. The Kadett was a very light car that looked good, was fun to drive and was replacing the VW beetle as *the* car to have in Germany. Hasegawa designed the Corolla around the same ideas as the Kadett. It was sized between the Publica (700cc) and Corona (1500cc)[9], looked classy, had modest power, yet was economical and inexpensive.

The Corolla was announced in 1966 and, according to Stephenson, by March 1968 more than 3,000 were being exported every month. In fact, once it was introduced into America in 1968 with its selling price of $1,800, sales there grew at a rapid pace. The Corolla was on the way to becoming "the people's car" for the entire world!

Perhaps the other most significant thing that happened in this decade was the signing of a Labor-Management Joint Declaration in 1962. As explained in the *Toyota Environmental & Social Report 2003* (under Social and Economic Aspects, Employees):

> Following a labor dispute in 1950, mutual trust between labor and management was adopted as the foundation of labor-management relations in the joint labor and management declaration concluded in 1962. Since then, repeated discussions have led to deeper understanding and trust between labor and management.

Considering the often-negative affect of unions on American automakers, this continuing effort on Toyota part to foster mutual trust and respect between labor and management surely has contributed to its success. Appendix C provides more

9) According to Stephenson, Nissan was coming out with its Sunny model a few months before the Corolla. Since the Sunny would have a new 1000cc engine Toyota told its engineers to increase the Corolla's new engine by 100cc from the planned 1000cc. Although difficult this late in the development, it was accomplished and Toyota could then advertise the Corolla as "the 100cc advantage."

information about this relationship.

Some other notable events that took place during the 1960s were (HOT):

- 1961: Toyota Motor Thailand Co., Ltd. established.
- 1965: Toyota awarded the Deming Prize, Japan's highest honor for quality.

  Toyota's Kamigo Plant (engines) starts operations.
- 1966: Toyota's Takaoka Plant starts operations—current main products: Corolla, Allex, Platz, Funcargo, Vitz, ist, Sienta, Porte.
- 1968: Toyota's Miyoshi Plant starts operations—current main products: drive trains, forged parts.

The 1970s. The 1970s saw Toyota continuing to advance in both sales and quality. As the Toyota Production System (TPS) became more and more refined, Toyota was able to ramp up production yet not at the expense of the quality and reliability of its vehicles. Having already won the Deming Prize in 1965, Toyota became the first company to be awarded the Japan Quality Control Medal. According the Union of Japanese Scientists and Engineers (JUSE) homepage (2006, under The Deming Prize):

The Japan Quality Control Medal

> When it is recognized that an applicant's implementation of TQM has improved substantially beyond the level at the time it won the Deming Application Prize, the company is awarded the Japan Quality Medal.

This was also the decade when Toyota came out with the Celica, it's popular sports car. In 1965 Toyota produced the sporty but small Sports 800, and then in 1967 a much beefier 2000GT. However, as Stephenson (under Celica History) puts it:

> The large Toyota 2000GT of the late 1960's was a success but was it was too expensive to manufacture. The small S800 was also successful but only

appealed to the outright enthusiast. Toyota wanted a new sports car that would appeal to more average buyers. It had to be easy to drive, practical and reliable.

Then, in 1978, Toyota introduced the Celica XX now known as the Supra. This was a beefed up Celica deriving much of its ancestry from the 2000GT. For many years these cars were extremely popular and used in competitions. However, according to two Wikipedia sites (Toyota Celica and Toyota Supra) production of the legendary Celica has all but stopped.

The Sports 800

The 2000GT

The Celica (1970)

Some other models that came out during the 1970s were: Carina (now Allion), Light Ace, Publica Starlet, Town Ace, Chaser, Tercel, and Corsa.

By 1972 Toyota had produced its ten millionth vehicle domestically and cumulative exports reached five and ten million units respectively in 1975 and 1979.

Some other notable events that took place during the 1970s were (HOT):

- 1970: Toyota's Tsutsumi Plant starts operations—current main products: Camry, Premio, Allion, Caldina, Wish, Prius, Scion tC.
- 1973: Toyota's Myochi Plant starts operations—current main products: engines, chassis casting parts.

  Calty Design Research, Inc. established at Newport Beach, CA to support North American operations and provide design solutions for many of Toyota's cars (see About Toyota under Operations, Design/R&D).

- 1975: Toyota's Shimoyama Plant starts operations—current main products: engines, turbochargers, variable valve timing, catalytic converters.
- 1977: Toyota Technical Center U.S.A., Inc. established at Ann Arbor, Michigan to support Toyota's North American engineering and R&D activities (see About Toyota under Operations, Design/R&D).
- 1978: Toyota's Kinuura Plant starts operations—current main products: drive trains, casting parts.
- 1979: Toyota's Tahara Plant starts operations—current main products: Celsior, GS, Ipsm, RAV4, 4-Runner, Land Cruiser Prado, engines.

The 1980s. Toyota's production and sales continue to soar. By 1985 cumulative exports had reached 20 million units and by 1986 Toyota had produced its 50 millionth vehicle domestically (HOT). Figure 1 show just how fast Toyota's production, sales, and exports were growing. Note that the 1980s were also when Toyota's overseas production began taking off.

No doubt the two most significant events for Toyota in the 1980s were the

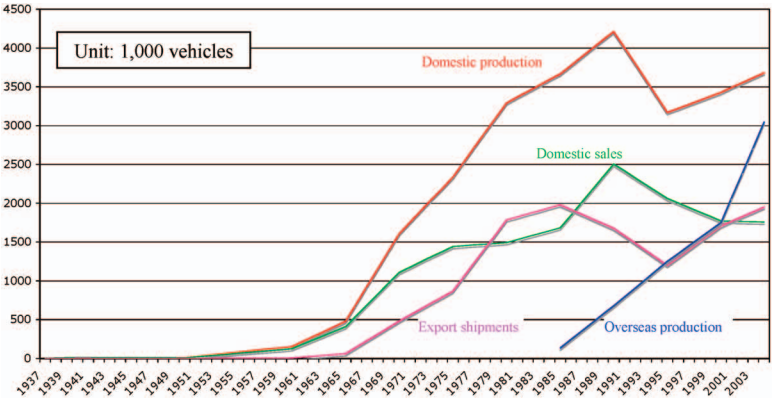


Figure 1. Trends in Toyota's domestic production, domestic sales, export shipments, and overseas production (adapted from Toyota Company Profile [TCP], p. 4)

start of the NUMMI operation in 1984 and the development of the Lexus during the last half of the decade. The New United Motor Manufacturing, Inc. (NUMMI) was established as a joint 50/50 venture with GM to reactivate a GM plant in Fremont, California. This huge plant continues to this day as a benchmark against which other U.S. plants measure themselves[10]. NUMMI's current main products are Toyota's Corolla and Tacoma pickup truck, and GM's Pontiac Vibe.

According to the English version of the Lexus homepage (Lexus History, 2006) the Lexus story started in August 1983: "At a top-level, top-secret meeting, Toyota Chairman Eiji Toyoda determines the time is right to create a luxury vehicle to challenge the world's best." By "the world's best" at the time was generally meant brands like Mercedes and BMW. As related in Liker (2004) to accomplish this feat, Toyota assigned Ichiro Suzuki as the lead engineer. Suzuki had become a legend within Toyota and was known as the "Michael Jordan" of chief engineers (p. 43).

After conducting a couple of focus group interviews with "luxury car" owners, Suzuki began compiling the features that he thought such people wanted. For example, in rank order, these were the things most important to buyers of Mercedes:

- Status and prestige of image
- High quality
- Resale value
- Performance (e.g., handling, ride, power)
- Safety. (Liker, p. 45)

Despite the relatively low rank of performance, Suzuki felt it was one of the most important attributes of a car and, as quoted in Liker, he wanted "…to build a car

10) Usually coming up short!

that beats Mercedes-Benz in the most basic function a car has, its driving performance." In fact, Suzuki set targets for the Lexus based on beating an "equivalent" Mercedes and BMW in five areas: top speed, fuel consumption, noise (quietness), aerodynamics, and vehicle weight (Liker, p. 47). The guiding philosophy for the development effort was a set of "no-compromise" goals as shown in Figure 2.

1. Great high-speed handling/stability	*YET*	A pleasant ride
2. Fast and smooth ride	*YET*	Low fuel consumption
3. Super quiet	*YET*	Light weight
4. Elegant styling	*YET*	Great aerodynamics
5. Warm	*YET*	Functional interior
6. Great stability at high speed	*YET*	Great C_D value (low friction)

Figure 2. The "No-Compromise" goals for the Lexus development (from Liker, 2004, p. 48)

1989 Lexus LS400

As can be seen, these are goals that normally work against each other so the challenge for the design team was to meet both simultaneously. For example the second set: "Fast and smooth ride YET low fuel consumption" required a completely new engine. When the engine engineers said such an engine couldn't be mass-produced, Suzuki asked if they could at least try to make *one*. When they finally managed to do this, they (the engineers) became excited about figuring out how to do it on a mass production basis. Thus, with patience, persistence, and encouragement, the Lexus began to take shape as Suzuki wanted and the proof is in the pudding in that it was an immediate hit

when it went on sale in the U.S. in September 1989!

Some other notable events that took place during the 1980s were (HOT):

- 1981: Toyota Motor Co., Ltd. and Toyota Motor Sales Co., Ltd. merged into Toyota Motor Corporation.
- 1986: Toyota's Teiho Plant starts operations—current main products: machinery, dies for casting/forging plastic molds.
- 1987: Toyota Technical Center of Europe established in Belgium (now TMME Technical Center).
- 1988: Toyota Motor Manufacturing, U.S.A., Inc. (TMM) starts operations in Georgetown, Kentucky (now Toyota Motor Manufacturing, Kentucky, Inc. [TMMK])—current man products: Avalon, Camry, Solara, engines.
- 1989: Toyota's Hirose Plant starts operations—current main products: electronic parts and components.
  Tokyo Design Center established.

The 1990s. Although Toyota had been steadily developing overseas production facilities it was in this decade that such production really took off. By 1994 annual overseas output had exceeded one million units (HOT) and was on the rise (see Figure 1). Toyota would continue to add new brands to its line up such as the Estima, Windom, RAV4, Avalon, Harrier, and, most significantly, the Prius hybrid.

In fact, introduction of the Prius in 1997 was to change the auto industry for all time, as it was a radical departure from the use of a gasoline or diesel engine only to power the vehicle. Now a gasoline engine would be coupled with a battery-powered electric motor to improve the car's fuel mileage. But the Prius didn't start as a hybrid. In the early 1990s there was concern that Toyota needed to begin thinking about how it could do a better job of developing and manufacturing cars as the company moved into the 21st century. This concern then

morphed into the Global 21 (G21) project to build a car that was just the opposite of the gas-guzzlers of the time. In fact the challenge was to build a car that was relatively small yet roomy inside and with radically better fuel economy. The initial goal was for a 50% improvement over the then current fuel economy. In 1994 management changed this to 100%. Given the state of technology at the time, this essentially eliminated everything except a hybrid gas/electric power combination.

Once the hybrid concept was decided on, the project began to move along, not a little influenced by Hiroshi Okuda, who became Toyota's president in 1995. When Okuda asked about when the G21 would be ready he was told the development team was "aiming for December 1998, 'if all goes well.'" To which Okuda replied:

> That is too late; no good. Can you get it done a year earlier? There will be great significance in launching the car early. This car may change the course of Toyota's future and even that of the auto industry.[11] (Itazaki, 1999 as quoted in Liker, 2004, p. 58)

1997 Prius

So the target launch date was now December 1997. As related in Liker, remarkable, even heroic efforts allowed the engineering team to not only meet that date but also better it by two months with an October 1997 launch! For more on this remarkable effort see Liker (2004), Chapter 6 and Taylor (2006).

Some other notable events that took place during the 1980s were (HOT & TCP):

- 1992: Toyota's Guiding Principles announced (see Appendix D).

11) And how right he was with almost every major manufacturer now coming out with hybrids.

Toyota Motor Manufacturing (U.K.), Ltd. (TMUK Ltd.) starts operations.

Toyota Motor Hokkaido, Inc. starts operations—current main products: transmissions, drive train parts, aluminum wheels.

Toyota motor Kyushu, Inc. starts operations—current main products: Harrier, Kluger V.

- 1998: Toyota Motor Manufacturing Indiana, Inc. (TMMI, Inc.) starts operations—current main products: Tundra truck, Sequoia, Sienna.

  Toyota Motor Manufacturing, West Virginia, Inc. (TMMWV) starts operations—current main products: engines, transmissions.

  Toyota Motor Tohoku, Inc. starts operations—current main products: mechanical and electronic parts.

The 2000s. The 2000s might be described as the decade of globalization for Toyota. For example these are some of the foreign operations by start year and their current main products listed under Toyota Up Close (Quarterly Highlights) (2006):

- 2000: Sichuan FAW Toyota Motor Co., Ltd. (SCTM) in China (Coaster, Land Cruiser Prado).
- 2001: Toyota Motor Manufacturing France S.A.S. (TMMF) (Yaris, engines).
- 2002: Toyota Motor Manufacturing Poland Sp.zo.o. (TMMP) (transmissions, engines).

  Toyota Kirloskar Auto Parts Private Ltd. (TKAP) in India (axels, propeller shafts, transmissions).

  Tianjin FAW Toyota Motor Co., Ltd. (TTMC) in China (Corolla, Vios, Crown, Reiz),
- 2003: Toyota Motor Manufacturing, Alabama, Inc. (TMMAL) in the U.S. (engines).

Changchun FAW Fengyue Auto Co. Ltd in China (Land Cruiser, Prius).

- 2004: Toyota Motor Manufacturing de Baja California S.de R.L. de C.V. (TMMBC) in Mexico (truck beds, Tacoma).

  FAW Toyota Changchun Engine Co., Ltd. in China (engines).
- 2005: Guangqi Toyota Engine Co., Ltd. in China (engines, engine parts [cam shafts, crank shafts]).

  Toyota Peugeot Citroën Automobile Czech, s.r.o. (TPCA) in the Czech Republic (Aygo).

  Toyota Motor Industries Poland Sp.zo.o. (TTIP) (engines).
- 2006: Guangzhou Toyota Motor Co., Ltd. in China (Camry)—planned as of this writing.

  Toyota Motor Manufacturing, Texas, Inc. (TMMTX) in the U.S. (Tundra)—planned as of this writing.
- 2007: Toyota Motor Manufacturing Russia, Ltd. (Camry)—planned as of this writing.

During the 2000s Toyota continues to come out with new models: Opa, Kluger V, Allex, Allion, Voxy, Brevis, Verossa, ist, Alphard, Succeed, WISH, Sienta, Avensis, Passo, etc., etc.[12)]

North American production continues to set records with a cumulative production of 10 million units achieved in 2002. In the same year the highly successful Prius achieved sales of 100,000 (HOT)[13)].

2002 was also the year Toyota entered Formula One (F1) competition which it continue to vigorously pursue (see Toyota F1 Team official site at http://www.toyota-f1.com/public/en/index_e. html).

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12) The Toyota Up Close reference (February, 2006, p. 11) show 75 different Toyota models and 8 different Lexus models as making up Toyota worldwide product line-up!

13) Demand continues to exceed supply.

The TF106

Toyota today. As stated on page one of the Toyota Up Close reference:

> Toyota Motor Corporation is one of the world's leading auto manufacturers, offering a full range of models, from minivehicles to large trucks. Global sales of its Toyota and Lexus brands, combined with those of Daihatsu and Hino, totaled 8.12 million units from January 1, 2005 to December 31, 2005*. Besides its own 12 plants and a number of manufacturing subsidiaries and affiliates in Japan, Toyota has 53 manufacturing companies in 27 countries and regions, which produce Lexus- and Toyota-brand vehicles and components. As of March 2005, Toyota employs approximately 265,800 people worldwide (on a consolidated basis), and markets vehicles in more than 170 countries. Toyota's automotive business, including sales finance, accounts for more than 90% of the company's total sales, which came to a consolidated ¥18.55 trillion[14] in the fiscal year to March 2005. Its diversified operations include telecommunications and prefabricated housing.
>
> *Total retail unit sales of Toyota/Lexus, Daihatsu and Hino vehicles.

Having somewhat briefly covered the history of Toyota let's now look at what makes Toyota tick so successfully.

3. The Toyota Way

This section is based on the work of Dr. Jeffrey K. Liker, which he published in his 2004 book *The Toyota Way*. Liker is a Professor of Industrial and Opera-

14) At ¥112/$ (May 9, 2006), $165.6 billion.

Dr. Liker, Ph.D.

tions Engineering at the University of Michigan (Ann Arbor) and has been studying Toyota for more than twenty years.

The basic idea of Liker's Toyota Way is that there is much more to Toyota's success than the commonly accepted view that it is due to the Toyota Production System (TPS). As we shall see, the TPS is only a part of the Toyota Way. Having just reviewed Toyota's history we have already picked up some clues as to why Toyota has been successful besides practicing its TPS. Take, for example, Sakichi Toyoda's and son Kiichiro's belief in hard work and persistence, and that they should think long-term and be contributing to the good of society. Take also the example of Kiichiro accepting responsibility for the company's troubles in 1950 and stepping down from the presidency. Take also the almost heroic efforts that went into the Lexus and Prius developments demonstrating Toyota's stick-to-itiveness in tackling the toughest problems until they are solved. These examples are but a few reflecting the Toyota Way that has becoming the very fabric of the company's culture. We will now take a look at the fourteen principles that comprise Liker's Toyota Way.

To add some structure to these fourteen principles, Liker came up with his "4P" model. This is shown in Figure 3. The 4Ps are: Philosophy, Process, People & Partners, and Problem Solving.

Associated with each P is one or more principles thusly:

- *Philosophy* (Long-Term Thinking)

  Principle 1: Base your management decisions on a long-term philosophy even at the expense of short-term financial goals.

- *Process* (Eliminate Waste)

  Principle 2: Create continuous process flow to bring problems to the

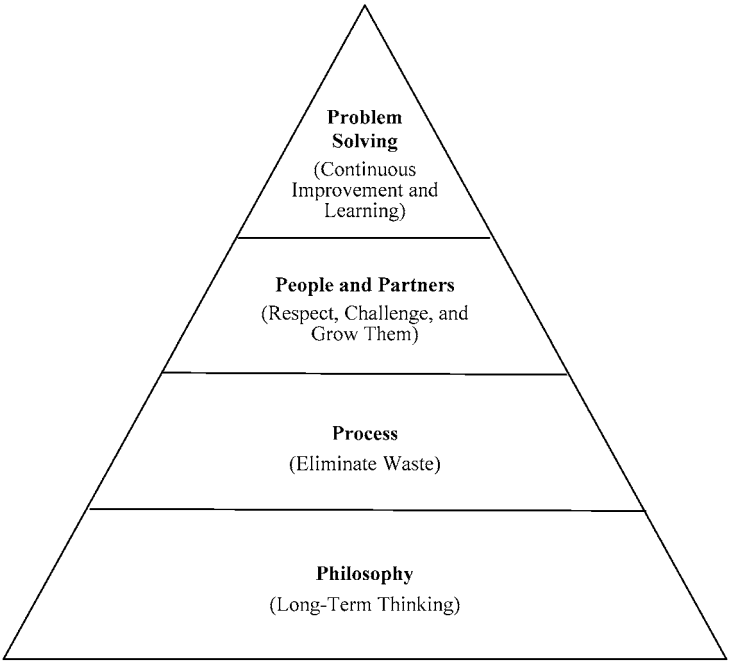


Figure 3. The "4P" Model (from Liker, 2004, p. 6)

surface.

Principle 3: Use "pull" systems to avoid overproduction.

Principle 4: Level out the workload (*heijunka*). (Work like the tortoise, not the hare.)

Principle 5: Build a culture of stopping to fix problems to get quality right the first time.

Principle 6: Standardized tasks are the foundation for continuous improvement and employee empowerment.

Principle 7: Use visual controls so no problems are hidden.

Principle 8: Use only thoroughly tested technology that serves your people and processes.

• *People and Partners* (Respect, Challenge, and Grow Them)

Principle 9: Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others.

Principle 10: Develop exceptional people and teams who follow your company's philosophy.

Principle 11: Respect your extended network of suppliers and partners by challenging them and helping them improve.

• *Problem Solving* (Continuous Improvement and Learning)

Principle 12: Go and see for yourself to thoroughly understand the situation (*genchi genbutsu*).

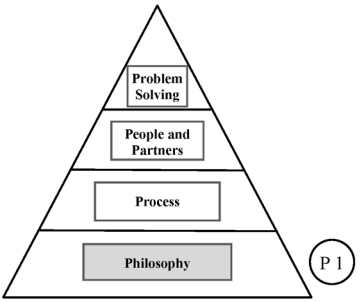
Principle 13: Make decision slowly by consensus, thoroughly considering all options; implement decisions quickly.

Principle 14: Become a learning organization through relentless reflection (*hansei*) and continuous improvement (*kaizen*).

Let's now learn more about each principle and see how it has contributed to Toyota's success. For a more succinct explanation of the principles see Liker's executive summary on pages 37 to 41 of his book.

Philosophy (Long-Term Thinking)—One principle

Principle 1: Base your management decisions on a long-term philosophy even at the expense of short-term financial goals. This principle says you should be acting in such a way as to improve the company as a whole, to bring value to the customer and society, and to accept responsibility for your own behavior.



Toyota's seven guiding principles (Appendix D) are evidence of this first "Liker" principle. Liker said from the numerous interviews he conducted for

his book the consistent message he got was that the purpose of the Toyota company was not short-term gain but looking beyond that to grow the company and do what is right for employees, customers, and society. As Liker so well puts it:

> Toyota's strong sense of mission and commitment to its customers, employees, and society is the *foundation for all the other principles* and the missing ingredient in most companies trying to emulate Toyota. (p. 72, emphasis in the original)

Everything Toyota does reflects this commitment to the company and society. It isn't trying to simply make a lot of money but to make itself better so it can do more for its employees, customers, partners, and society as a whole, sort of a "vicious circle" but a good one!

Liker gives numerous examples. One is from an interview with Jim Press[15] who used to work for Ford before coming to Toyota. His experience at Ford was one of chronic customer complaints whereas once he came to Toyota: "In contrast, Toyota is aligned around satisfying the customer. It felt like I finally had found a home" (as quoted in Liker, p. 73).

Another example is the way Toyota took a failed GM plant in Fremont, California and, with persistence, turned it into one of best plants in America, NUMMI[16], thus restoring jobs and contributing to the economy.

Toyota has always believed in taking responsibility for its own problems. The thought of a government bailout would seem very strange to a company like Toyota. Toyota has faced and overcome many challenges in its past such as its initial efforts to build cars that would compete with the likes of GM and Ford with it's then meager resources. Such difficulties prompted the ideas of "just-in-time" and "pull." Another example is how Toyota managed to pull

15) Executive Vice President and COO of Toyota Motor Sales in North America (at that time anyway).

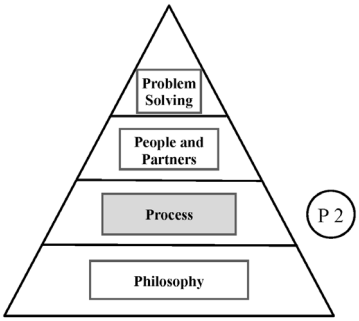
16) New United Motor Manufacturing, Inc.

through its financial crisis in the 1950s. As Liker notes, even the relatively isolated location of Toyota in the Nagoya countryside shows a penchant for not relying on others.

As opposed to what is too often the case with other companies, Toyota's seven guiding principles (Appendix D) are not just window dressing but something the company lives and breathes each day. Truly Toyota practices the Deming first point (Appendix B): *Point 1: Create constancy of purpose towards improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs.*

Process (Eliminate Waste)—Seven principles

Principle 2: Create continuous process flow to bring problems to the surface. Continuous flow is the opposite of traditional batch and queue. Companies often believe they can be the most efficient by making or working on as many of the same part as possible at the same time; i.e., taking advantage of the economies of scale. Therefore a traditional manufacturing company might have separate departments for stamping, welding, assembly, etc. As Liker points out (p. 91) once you have set up your operation this way the next question is how do you move these batches from one department to another, and when? This means you need another system to plan all this, which also means adding to the non-value adding bureaucracy. And, worse yet you have generated a massive amount of work-in-process (WIP) inventory that is just sitting around waiting to be moved/used[17] and con-



17) And probably far too often forgotten about as new products are developed.

suming valuable space and capital. Figures 4 and 5 from Liker illustrate the difference between a batch and queue set up and a continuous flow set up.

As can be seen in Figure 5, the ideal "batch" size is one. Furthermore, continuous flow operates on the principle of "pull." This means a part/operation

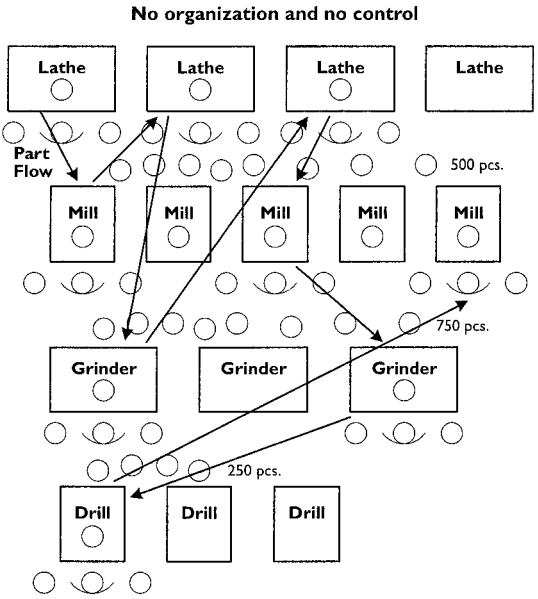


Figure 4. Organization by machine type with convoluted flow (batch and queue) (from Liker, 2004, p. 97)

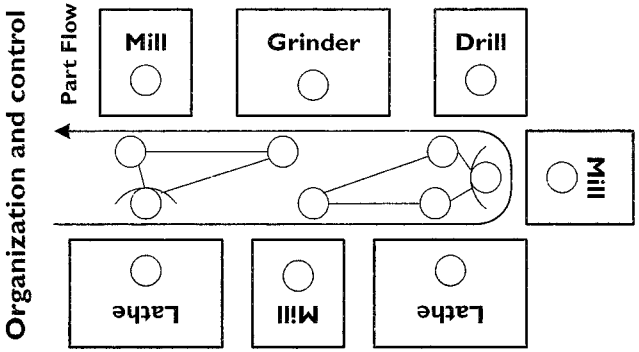


Figure 5. The U-shaped one-piece flow cell (continuous flow) (from Liker, 2004, p. 98)

upstream is only made/performed when the next downstream operation places the demand for it. Thus, in an ideal setup, all inventory is eliminated[18].

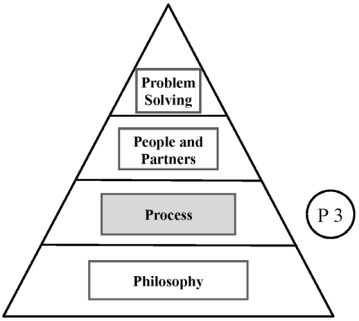
As pointed out in Liker (pp. 95-96) these are the benefits of continuous flow:

- Improves quality since a part is moved one at a time forcing the operation receiving the part to ensure it is OK. When there is a lot of inventory from which an operation is working it is too easy (and human nature) to just toss the bad part and grab another. Then whatever caused that bad part never gets addressed.
- Improves flexibility since the order-to-delivery cycle time is much shorter and, if the customer's needs change, it becomes much easier to respond to the change.
- Improves productivity since it is much easier to determine exactly how many resources (people, machines, etc.) are needed when you are making just what's needed.
- Frees up all that floor space that was wasted holding, as Liker puts it, "piles and piles" of inventory.
- Improves safety since smaller amounts of material are being moved. This means less chance of lifting strain and accidents involving the equipment needed for moving large batches (such as forklift trucks).
- Improves morale because the workers can see better that what they're doing is truly value-adding and not just churning out hundreds of parts without really knowing why.
- Reduces the cost of inventory as already discussed.

Principle 3: Use "pull" systems to avoid overproduction. In the ideal one-piece flow an operation does not get what it needs from the next upstream operation until it calls for it, in other words there is zero WIP inventory between op-

18) In reality, depending on the lead time for the upstream part, some buffer inventory may be required.

erations. This is called "pull" because the operation is "pulling" what it needs versus having it being "pushed" on to it for use. As mentioned, in a traditional batch and queue operation a lot of parts are made or processed at the same time and then placed in an inventory and moved to wherever they'll be used next waiting to be used. Obviously this creates a lot of waste. Although in a mass production system, such as Toyota's, it is not possible to have perfect one-piece flow, the idea of pull is applied to the maximum extent possible.



The idea for this, as the story goes, came when Taiichi Ohno visited the U.S. in the 1950s and became fascinated by the way supermarkets operated. Instead of a lot of inventory being held by these stores, the customer was "signaling" what should be bought from the wholesalers and when it should be bought. This "signal" was simply how much of each item was bought requiring it to be replenished to the shelf. Another example Liker gives is the gas gauge in our car signaling us when it's time to fill up.

Applying this idea to manufacturing, the question became how to best signal the source of supplies for any operation when more supplies are needed. Thus was born the famous *kanban* system. A *kanban* is simply some device to signal the next upstream supply source that more of whatever it supplies is needed. *Kanban* in Japanese means card and a card of some sort is usually used along with a standard size container for that particular item. Figure 6 illustrates the *kanban* concept. At the far right an operator is using up parts from a standardized container. Once those parts are used up, the empty container, along with it "parts retrieval *kanban*" goes back to a nearby replenishment store for refilling and return to the operator. Of course while this replenishment is going on another

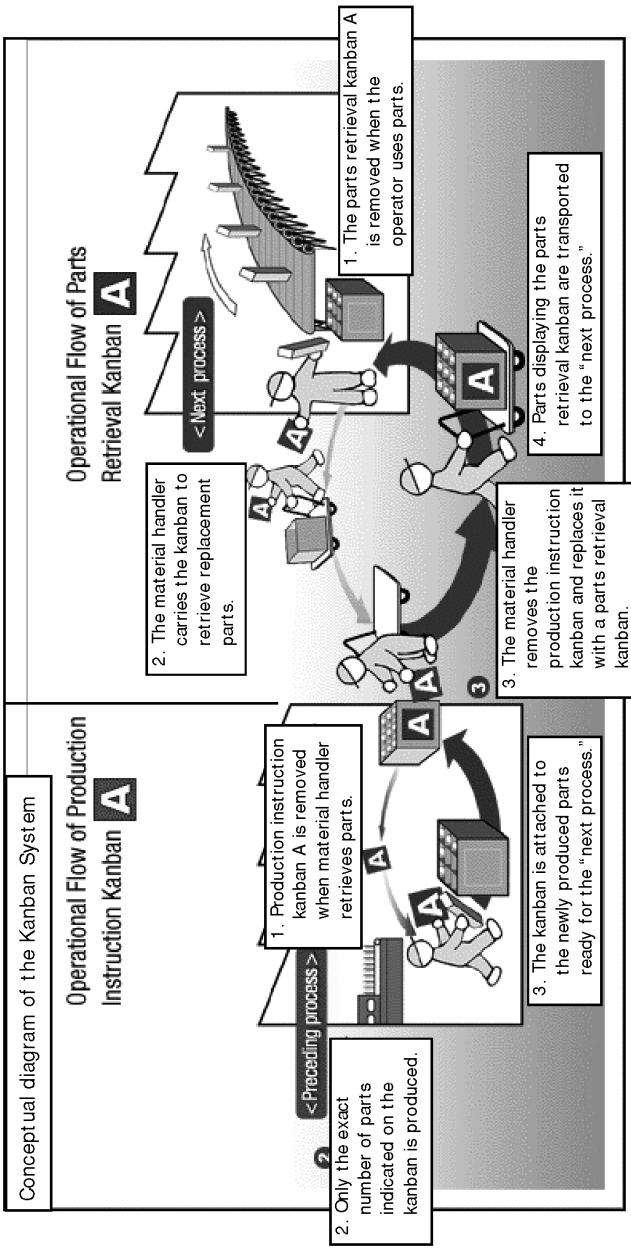


Figure 6. The *kanban* concept (adapted from Toyota Production System, 2006)

container[19] is in the system to allow the operation to continue.

In turn, as the replenishment store's stock goes down and reaches a certain level, a "production instruction *kanban*" is triggered and sent back to the producer for producing a certain amount to be sent to the replenishment store. This is shown on the left side of Figure 6. Of course not all production facilities are so close that such precisely timed replenishment can occur. Therefore some parts must be moved in larger quantities on a scheduled basis, for example parts coming from overseas. However, even these replenishments should be as often as practical to minimize inventory.

As Liker points out it is not simply an "either/or" situation but where possible a *kanban* pull system is used and even that should be as streamlined as possible by, for example, trying to minimize what's held in the buffer replenishment stores and the amount of material moving between sources and destinations. The idea is not to set up an elaborate *kanban* system *but to eliminate waste*. The *kanban* is simply the means to do this, not an end it itself!

To show how this pull principle works within Toyota, Liker (pp 108–109.) describes how it starts with the customer, just like the supermarkets:

> Orders accumulate from car dealerships. Production control creates a leveled schedule[20]. For example, they make a white Camry, followed by a green Camry, followed by a red Avalon, and so on. Each of these cars has a whole set of options associated with it. That schedule is sent to the body shop, where stamped steel panels (from a "supermarket" of pre-stamped panels) are welded together into a body…. …At a certain trigger point when a certain number of steel panels have been used by the body shop, a *kanban* goes back to the stamping press, ordering it to make another batch to replen-

19) Or however many are needed, but the number should be as small as possible to keep that inventory down.

20) See Principle 4 next.

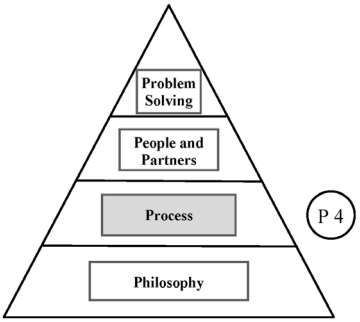
ish the store.

Similarly, when assembly line workers begin to use parts from bins (hinges, door handles, windshield wipers), they take out a *kanban* card and put it in a mailbox. A material handler will come on a timed route and pick it up and go back to a store to replenish what is used on the assembly line. Another material handler will replenish the store based on parts from a supermarket of supplier parts. This will trigger an order back to parts suppliers. And so on.

Although Figure 6 makes it appear to be a simple matter, when you take into account that a car has thousands of parts and each car is different, the development, maintenance, and continual efforts to improve Toyota's pull system represent a remarkable feat. But this is not to say other manufacturers can't also do it, and many have, recognizing the great payoff in reducing costs and cycle times and increased customer satisfaction.

*Principle 4: Level Out the Workload (*Heijunka*)*. When we discussed creating flow (Principle 2), several benefits were listed. Another way to describe the benefits of flow is that it helps eliminate waste and this is the whole purpose of lean manufacturing. According to Liker (p. 89) there are eight "non-value-adding" wastes:

- Overproduction
- Waiting
- Unnecessary transport
- Overprocessing
- Excess inventory
- Unnecessary movement
- Defects
- Unused employee creativity



The Japanese word for waste is *muda*. Principle 4 is concerned with two other

"M's": *muri* and *mura*. *Muri* is overburdening your people and machines and *mura* is unevenness. Although in the process of going lean a company is trying to get the most out of its processes, this doesn't mean pushing those processes beyond their natural capability (*muri*). However, this is what usually happens in a company because of the unevenness (*mura*) that exists.

Say a company is making two products, a fairly large and complicated one and a less expensive, simpler one. The time and effort required to make the more complicated model will always be greater than the time and effort required for the simpler one. Therefore, when there is strong customer demand for one model or the other the manufacturing process will either be overburdened or under burdened. That is, when trying to meet demand for the more complicated model every worker and machine will be overworked and when the demand shifts to the simpler model there will probably be a lot of "free time." This is especially true for "build-to-order" type of operations. In such cases companies will often have a lot of the most popular products being held in expensive finished product inventory.

Another reason for this unevenness is companies tend to build a lot of one model at a time due to the time it takes to set up the tools and equipment for another model. Primarily based on the pioneering work of Shigeo Shingo who worked closely with Toyota, previous setup times that were measured in hours are now measured in mere minutes. A lot of this was accomplished by carefully studying what was required to effect the changeover—for example of a large stamping press—and doing as much of it as possible while the press was still operating. It turns out that often there are only a few things that still need to be done to affect the changeover thus allowing it to be accomplished quickly.

To minimize *mura* and thus minimize *muri* and the *muda* it causes, Toyota practices *heijunka*. *Heijunka* means leveling to even out the workload as much as possible. This is also known as "balancing the line" and, according to Scholl &

Klein (2006), for mixed model assembly lines such as Toyota's, a key factor is solving the model-sequencing problem. This means finding "a sequence of all model units to be produced such that inefficiencies (work overload, line stoppage, off-line repair, etc.) are minimized." Given Toyota's ability to meticulously plan everything, they have essentially solved this problem. Toyota's ability to quickly affect changeovers also greatly contributes to *heijunka*.

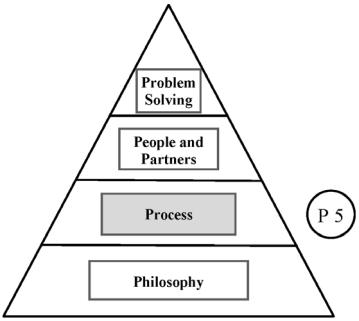
One of the benefits of this line leveling is the stabilizing affect it has on the whole supply chain. When a supplier knows he or she can almost always depend on the schedule planned by Toyota, their operation too becomes "evener" as does that of his or her suppliers in turn, etc.

Although *heijunka* may entail making some customers wait a little longer for the particular car they want, the net effect benefits everyone. However, even with *heijunka* in place, Toyota has been working to make it possible for dealers to call in with "last minute" changes so that many times any change "except for the basic body type" can be accommodated (Liker, p. 122).

One way to think of *heijunka* is like the race between the tortoise and the hare. As quoted from Ohno (1988) in Liker (p. 115):

> The slower but consistent tortoise causes less waste and is much more desirable than the speedy hare that races ahead and then stops occasionally to doze. The Toyota Production System can be realized only when all the workers become tortoises.

Principle 5: Build a culture of stopping to fix problems to get quality right the first time. According to Liker, the traditional approach to manufacturing by companies like GM and Ford has been to keep the assembly line running at all costs. On the surface this seems to make sense.



However, it also causes and hides a lot of problems since to expect a complicated operation such as an automobile assembly line to operate problem-free for any length of time really makes no sense. Therefore Toyota goes to great lengths to create an operation that can stop when there is a problem. The idea is to not only prevent bad product but also solve the problem, be it a temporary aberration or something that could cause long-term quality problems.

This building of a system that has the inherent ability to prevent bad quality from being produced goes back to Toyota's automatic loom origins when Sakichi Toyoda invented a loom that would automatically stop if a thread broke. The Japanese term is *jidoka* and, along with just-in-time, is considered one of the two "pillars" of the TPS. The elements of *jidoka* are:

- Devices built into the machine or system to prevent a wrong operation or to stop the process or cause a signal to occur when a problem occurs.
- Employees who are authorized to stop an operations when they notice a problem.
- Employees who are trained on how to respond to stoppages (e.g., a team leader who will quickly help an assembly line worker).
- Standardized work procedures.

Devices to either prevent a wrong operation or alert the operator when one has occurred are called *poka-yoke* or, in English parlance, fail-safe devices. There are many examples such as the third prong on most U.S. electrical plugs meant to ensure it is inserted so a proper ground occurs. Liker gives the example of a certain cotter pin that needs to be inserted in assembling an axel. A light curtain must be passed through when reaching for the cotter pin. If this doesn't happen a light goes on. Signals such as this are called *andon* and are used throughout Toyota. An *andon* is simply a signaling device and could be a light or an audible signal. For example, above the Toyota assembly lines are light boards that will light up to show which work station is having a problem so the team leader can

quickly attend to that problem.

The line worker usually activates these *andon* lights on Toyota's assembly lines when he or she sees a problem. Furthermore when activated the assembly line is temporarily stopped. The worker is not only authorized to stop the line but also is expected to do so—almost the ultimate empowerment. At the same time a highly trained team leader will immediately step in to assess the situation and take whatever action is required. Figure 7 shows how this works and Liker describes how it applies to a Toyota assembly line:

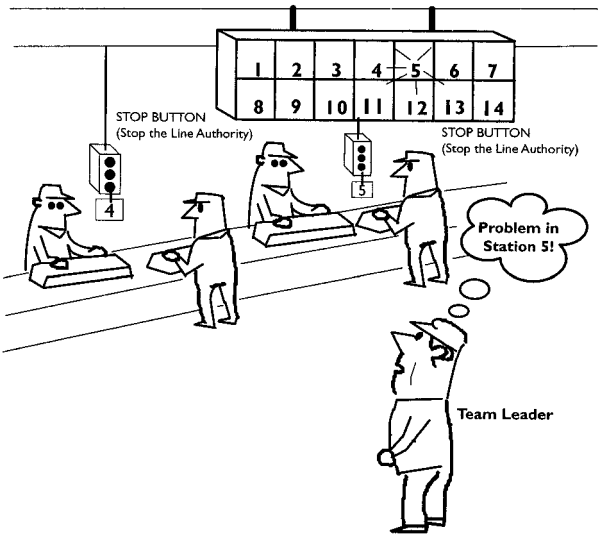


Figure 7. An assembly line with andon lights and work stoppage buttons (Liker, 2004, p. 131)

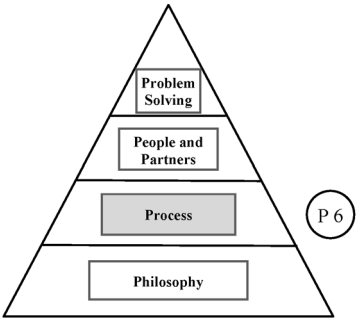
> The team leader has until the vehicle moves into the next workstation zone to respond, before the *andon* turns red [from white] and the line segment automatically stops. This is likely to be a matter of 15–30 seconds… In that time the team leader might immediately fix the problem or note it can be fixed while the car is moving into other workstations and push the button

> again, canceling out the line stoppage. Or the team leader might conclude that the line should be stopped. (p. 131)

However, since the line is divided up into segments with buffer in between, up to 10 minutes could pass before the entire line has to stop. As Liker says, this rarely happens. When I visited a Toyota plant recently I noticed while we were watching an assembly line that the *andon* lights were often coming on but almost as often they were quickly turned off as each "problem" was quickly attended to.

The final element of a good *jidoka* system is standardized work. This applies not only to how problems are responded to but also to each operation on the assembly line. In fact the two are related since should a new problem spring up that hasn't been encountered before, the first step will probably be to carefully review the way the operation in question is presently being performed—without standardized work procedures this would be impossible. After a careful analysis of the existing procedure and why it failed, the necessary changes to it can be made.

So the idea of *jidoka* and building quality into the product by ensuring any problems are immediately nipped in the bud has many benefits. These include ensuring extremely high-quality product, making each worker feel like he or she really is making a difference, encouraging and letting everyone continually practice problem solving, and creating a culture that says "problems will occur, let's work together to solve them and not waste time blaming people!"



Principle 6: Standardized tasks are the foundation for continuous improvement and employee empowerment. When we think of standardized work we think of

some controlling, all knowing bureaucracy that develops the standards and imposes them on the poor worker. Such was the legacy of Fredrick Taylor whose well-intentioned efforts to get more out of each worker often made the job so onerous that the worker resisted to the point where any gains were wiped out by this resistance. At Toyota the emphasis is not on "control" but on "empowerment." Toyota too has a bureaucracy but one whose purpose is to support the worker by ensuring that the work standards are "best practice standards" versus coercive "performance standards."

The philosophy behind Toyota work standards is you can't improve something if it isn't stable. Liker uses the example of improving a golfer's swing; if he or she has not yet learned to swing consistently, it will not be possible to improve it. Similarly, if a certain way of doing something on the assembly line hasn't been standardized so it is always done the same way, it won't be possible to move to an improved level.

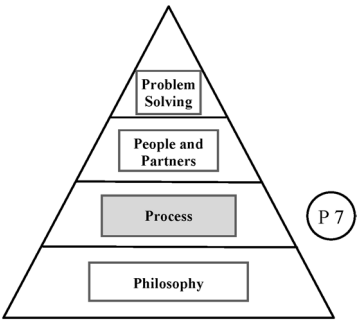
And this improvement is largely left to those doing the work since they are in the best position to know how to improve it. However, Liker also mentions what happens when something appears to go wrong during normal operations: the standardized procedure will be checked to see if it was followed. If it was, then the team/group leader will watch as the worker goes through the procedure to see what needs changing.

But the idea of letting the worker him or herself make improvements is very empowering and is probably the reason Toyota gets so many useful suggestions from its workforce[21]. This is one way Toyota encourages its employees to follow its motto: *Good Thinking, Good Products.* Also, by having the workers write and improve the standards ensures they will be in a "language" that the worker can understand.

21) Toyota has a very active suggestion program and implements the vast majority of them!

Recognizing the great variation in type of tasks, from those that are highly repetitive to those less so (like design work), Toyota strives to find the proper balance for each task. For the highly repetitive tasks the standards will be very detailed, for those at the other end of the spectrum there will be more room for individual initiative in doing the task. However, it must be again emphasized that even for the detailed standards, the worker is empowered and expected to come up with improvements to it reflecting a culture that says "you're important and we want to know what you think will make our company better."

Principle 7: Use visual controls so no problems are hidden. Liker starts talking about this principle by describing how most companies outside Japan[22] operated: with "piles and piles of inventory stacked to the roof" so you couldn't see if everything was where it should be[23] or if the work was being performed as it should. This resulted in a problem being hidden until the company is forced to address it. And, by that time, the problem was so serious it had become a crisis. In fact, "crisis management was the accepted mentality of the day" (p. 149).



Liker quotes Fujio Cho, a recent president of Toyota, about how Taiichi Ohno, the "father" of TPS felt about visual control:

> Mr. Ohno was passionate about TPS. He said you must clean up everything so you can see problems. He would complain if he could not look and see and tell if there is a problem. (p. 149)

It is safe to say you can't have a good lean system without good visual controls.

22) And probably some in Japan.

23) As an aside, on page 104 Liker has a great Taiichi Ohno quote: "The more inventory a company has,... the less likely they will have what they need."

Visual controls could be anything that helps you see if things are where they should be and the work is being performed as it should. For example, a good lean system will include the practice of 5S. The five S's are: sort, straighten, shine, standardize, and sustain. *Sort* what is needed in the work place from what's not needed and get rid of what's not needed. *Straighten* up what's needed, for example by arranging all the tools at a work station in a way so the worker knows where each tool is and knows immediately if a tool is not there.[24] Continually *shine* up everything to keep tools, equipment, and the work area clean and well-working and to be able to quickly detect any problems such as leaky pipes. Have *standards* for carrying out the first three S's and periodic audits to *sustain* and constantly improve the 5S system.

Some other visual controls include the use of *kanban* cards to tell when a bin needs filling, markings on the plant floor to show where WIP or a parts bin should be placed, and—as discussed under Principle 5—*andon* lights and standard work procedures. The standard work procedures are posted at each workstation and are the current best practices for that work.

As Liker puts it: "In essence, Toyota uses an integrated set of visual controls or a *visual control system* designed to create a transparent and waste-free environment" (p. 153). Such a system allows the supervisor to walk through an area and immediately tell if the work is being performed as it should or if any problems exist.

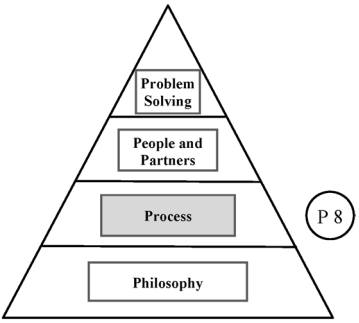
Liker gives several examples of how a good visual control system can greatly improve an operation. For example a process control board at a Toyota parts distribution center in Kentucky allows almost minute by minute monitoring of a highly sophisticated picking operation thus making the operation very efficient. Another example is in the area of product development that started with the

24) In other words: "A place for everything and everything in its place." Tool shadow boards are an example.

Lexus development. For a new development Toyota now sets up an *obeya* (large room) where everything relevant to that development is displayed: schedules, design graphics, manpower charts, financial status, quality information, etc. Also the chief engineer and his/her key people work out of this room. Such a system provides everyone involved a full picture of what's going on at any time. It also facilitates coordination among the various functions eliminating a lot of previous waste in "transporting" information from one function to another.

It is interesting that most visual controls are manual systems such as the *kanban*[25] and *obeya*. With the remarkable advances in computer technology and the advent of the Internet and intranets it is tempting to try and do more visual controlling with this technology. However, as Liker notes, such can often have unintended consequences. For example when some visual control requires a person to log on to a computer to see it there is a good chance that will never happen. Often a tried and true manual system that makes the visual control plainly visible to everyone is the best.

Principle 8: Use only thoroughly tested technology that serves your people and processes. Toyota believes in adopting new technology but only to the extent it truly supports its people and processes. Too often a company will be enticed into adopting some new technology based on the vendor's promises of how much more efficient it will make some process or operation[26]. Liker gives the example of an American auto parts supplier that felt its operation would be



25) However, in some cases where it makes sense, electronic *kanbans* are being used.

26) Often such new technology soon falls into disuse because it is deemed more trouble than it is worth ("act in haste, repent in at leisure").

greatly improved by adopting software that allowed anyone real time visibility of inventory in the supply chain (p. 161). The object was to increase its inventory turns. As Liker pointed out to the company, just knowing what was in the supply chain without actually doing anything to reduce inventory[27] would not help. And, in fact, Liker later proved this by cutting inventory by 80% at one of their plants *without any information technology*.

Contrast this with the way Toyota's service parts operation views technology. As Liker states it:

> …they continue to use an old software system developed in house years ago under much simpler circumstances. It has continuously evolved over the years and does exactly what is needed today. (p. 161)

Typically, when Toyota is considering adopting new technology it will first study the process that will be affected and be sure that everything possible has been done without that technology to make the process efficient. Then a pilot program will be carefully run to ensure the new technology really will significantly improve the process without distracting the worker(s) involved. In other words, the new technology must truly add value to the process and make it easier for the worker(s) to do a good job. In some cases the new technology will be adapted to meet Toyota's specific needs versus being adopted wholesale. An example given by Liker is when Toyota decided to consider using CATIA[28] and in the event customized it to "fit their development process." Toyota's adoption of CATIA is also an example of how thoroughly it studies technology before making that final decision since, according to Liker, it was only "after two years of thinking and debating" that Toyota decided to make the shift. The bottom-line is will the new technology *really* support Toyota's people and processes.

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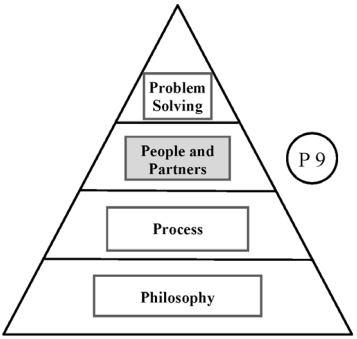
27) Such as introducing a *kanban* system.

28) Computer-Aided Three-Dimensional Interactive Application—CAD software that is now considered "the auto industry benchmark."

People and Partners (Respect, Challenge, and Grow Them)—Three principles



Principle 9: Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others. When compared to most other major automakers, Toyota top leaders are quite different. Most of the others tend to bring in outsiders, often for the purpose of "turning the company around." A case in point is Carlos Ghosn of Nissan. Toyota believes in growing its leaders from within. For example the current president, Katsuaki Watanabe, who took over in early 2005, oversaw procurement and business development at the time of being named to that post. He also came with experience in production and corporate planning (Toyota Names New, 2005). In fact Watanabe represents a continuation of a long line of such presidents dating from the founder, Kiichiro Toyoda. What is most significant about this line is how it has preserved the traditional values that actually started with Kiichiro's father, Sakichi. These are such things as hard work, having first-hand knowledge of the work, and making customer satisfaction and the good of society important priorities.

The continuation and promotion of traditional values such as these provide Toyota the stability it needs to be a true learning organization and progress to the next level of excellence. Contrast this with organizations that are up one day and then in the doldrums the next, requiring the next drastic shakeup, maybe by bringing in a "turn around artist."

The idea of a learning organization also means Toyota places a genuine value on its people. Figure 8 is Liker's view of how Toyota leadership differs from other companies and how it focuses on building a true learning organization by

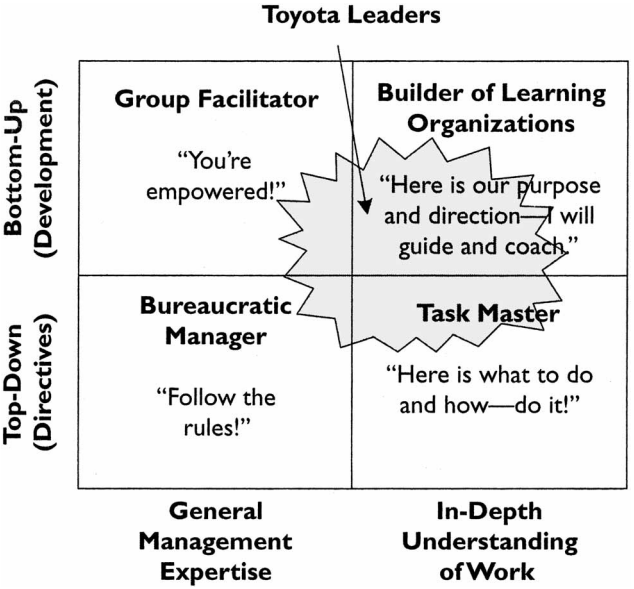


Figure 8. Liker's Toyota leadership model (p. 181)

the way it treats its people[29]. The *bureaucratic manager* has little understanding of the value-added work being done and leads by enforcing the rules. The *group facilitator* may be a great motivator but can he or she really provide that much guidance on how to do the job. There is probably little respect for either of these leaders—one a "command and control" type and the other a "feel gooder"—both know less than the workers about what's really going on. The *task master* is the micro-manager who does know what's going on but has little faith in the workers, directing their almost every move and again, probably getting little respect.

The Toyota leader operates mostly in the fourth quadrant: the *builder of learning organizations*. He or she not only knows what's going on because of having "been there," but also is firmly committed to the Toyota Way of doing

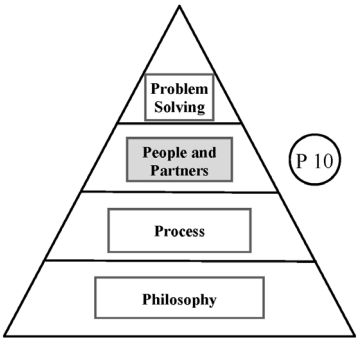
29) More on this at Principle 14.

things and seeks to pass this on to his or her subordinates. As shown by the shading in Figure 8 sometimes it is necessary to operate in the other three quadrants depending on the situation. Liker sums up the common traits of Toyota's past great leaders:

- Focused on a long-term purpose for Toyota as a value-added contributor to society.
- Never deviated from the precepts of the Toyota Way DNA and lived and modeled themselves around this for all to see.
- Worked their way up doing the detailed work and continued to go to the *gemba*—the actual place where the real value-added work is done.
- Saw problems as opportunities to train and coach their people. (p. 182)

Such leaders are respected for both their knowledge of the business and leadership abilities. As opposed to the bureaucratic manager or task master they seldom give orders. Instead they ask people questions to encourage them to think problems through themselves and thus learn so the whole organization becomes better.

Principle 10: Develop exceptional people and teams who follow your company's philosophy. Toyota believes that you cannot get exceptional teams without hiring and training exceptional people. Liker relates how employees were selected for a new service parts facility in Hebron, Kentucky. Out of a total of 13,500 applicants for the 275 jobs a subset of randomly selected applicants was chosen to attend a job fair. At the job fair these applicants were further screened and given information about Toyota. Finally, based on the job fair, certain applicants were invited to undergo three one-hour interview meetings.



In the year leading up to the launch of the new facility only some of the jobs were filled to form a design team to develop the operational process and begin learning the Toyota Way. This cadre of workers was also used to help select additional "associates" as the operation gradually ramped up.

The point is that rather than immediately begin a full-fledged operation, the Hebron launch was well thought out and gradual to ensure not only the best people were selected but also that there was enough time to, in effect, *build the culture first*. This began with the job fair where information was given out about Toyota and how it does things, through to the training and assimilation of more and more associates as the launch progressed. No doubt, Hebron is a model of how Toyota wishes to bring on board not only the best and brightest but also those who will share its traditional values and make good team members.

In most organizations the hierarchy is top-down, in Toyota it is "bottom-down"; that is, the team members are considered the most important people *since they are the ones adding value for the customer on the assembly line*. Figure 9 shows this along with typical spans of control. At first glance the excessive number of group and team leaders would seem a waste of manpower. However, com-

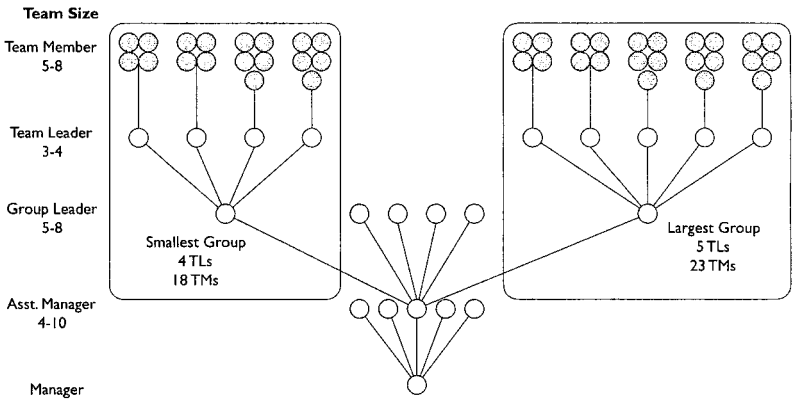


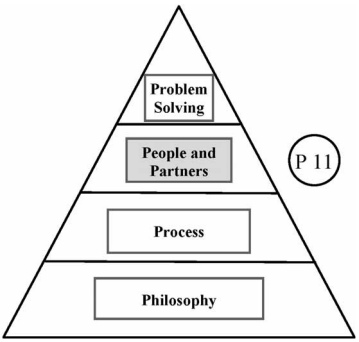
Figure 9. Toyota's "bottom-down" hierarchy (from Liker, p. 192 [original source: Bill Constantino, former group leader, Toyota, Georgetown, Kentucky])

pared with most companies, these team and group leaders are not just standing or sitting around to "supervise" the work but have many specifically assigned duties all designed to provide maximum support to the team members doing the work. And not least of these is to fill in for a team member when necessary or be ready to aid assistance when a problem arises. As mentioned earlier, each team member has the authority—and responsibility—to stop the line when a problem arises. This signals the team leader who is immediately available to lend assistance or make a decision about what to do. And, from my recent experience of visiting a Toyota plant, it was apparent from all the times the *andon* lights came on that these team leaders were kept busy and earning their pay.

Liker (pp. 194–197) describes how Toyota firmly believes in the various motivation theories such as the Maslow and Hertzberg "internal" theories and the "external" theories of Taylor and Skinner. However, there is much more to developing exceptional people and teams than simply trying to apply these theories. It requires building a culture that integrates your technical and social systems and is based on a consistent set of principles and this is something that takes years.

As far as motivation, Liker sums it up well:

> People must have a degree of security and feel they belong to a team. You must design jobs to be challenging. People need some autonomy to feel they have control over the job. Moreover, there seems to be nothing as motivating as challenging targets, constant measurement and feedback on progress, and an occasional reward thrown in. (p. 198)



And this also sums up well the way Toyota develops and treats its people.

Principle 11: Respect your extended network of suppliers and partners by

challenging them and helping them improve. It doesn't take a "rocket scientist" to realize that if you want a quality product you must use quality supplies. This was one of Deming's Fourteen Points (Appendix B): *Point 4: End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust.*

The importance of having a close relationship with your suppliers can be appreciated even more when you consider the thousands of parts that go into each car and the diversity of these parts depending on the car model (at last count Toyota makes some 80 different models). Then add in the need to have as many of these parts arrive "just-in-time" to many places all over the world. When viewed this way it becomes obvious that Toyota's suppliers are very special to Toyota's success and Toyota treats them accordingly.

As Liker points out, Toyota came by this idea of having a special relationship with its suppliers honestly since in its early days it simply didn't have the volume that would normally attract a supplier. What it could offer was a chance to grow together with Toyota. As Liker puts it:

> So, like the associates who work inside Toyota, suppliers became part of the extended family who grew and learned the Toyota Production System. (p. 202)

And once a supplier has proved itself by meeting Toyota's tough standards it is "not kicked out except for the most egregious behavior."

Toyota works closely with its suppliers to help them learn and practice the TPS and, hopefully, even some of the Toyota Way. One such effort is the Toyota Supplier Support Center (TSSC) established in 1992 in the U.S. (Erlanger, Kentucky). Although originally its services were free, TSSC has become a pay-for-service consulting firm. TSSC operates on a project basis, going into a company and, over a period of several months setting up a model assembly line based on

the principles of the TPS.

According to Liker another way Toyota supports its suppliers is by closely monitoring and rating them. A rating of "one" means the supplier has completely shut down due, say, to its plant burning down; a "five" is exemplary. If a supplier puts a Toyota assembly plant in danger of shutting down it is rated "two" and this happens:

> Toyota will then send in a team of people swarming through the supplier's plant and the supplier must develop an action plan to address all of their concerns. A level two typically means severe probation for a year. (pp. 212–213)

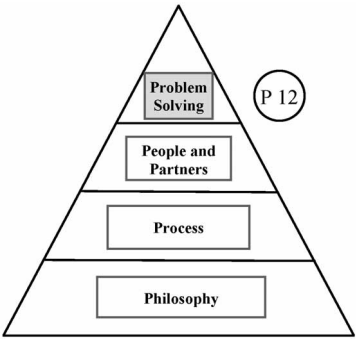
But note that the supplier is not simply chastised or dropped as might happen with other major automakers, but helped to recover to again begin meeting Toyota's high standards. Again we see this general theme in the way Toyota operates: working with its partners to solve the problem not wasting time on the "blame game." This is the way it works with its employees too. And, in the end, everyone wins with better suppliers and better employees.

As Toyota continues to refine the way it develops and supports its suppliers, bringing them closer and closer to the ideal of not just the TPS but the Toyota Way, we see the what Jeffrey Liker believes is a unique achievement: "…an extended learning enterprise. This is, to me, the highest form of the lean enterprise" (p. 217).

Problem Solving (Continuous Improvement and Learning)—Three principles

*Principle 12: Go and see for yourself to thoroughly understand the situation (*genchi genbutsu*)*. On the surface this principle seems very simple even though it may not be practiced that much by most companies. It reminds me of another management "rule": manage by walking around; that is, don't stay in your office all day but get out and see what's really going on. However, for Toyota this principle is considered throughout the company as what most distinguishes its man-

agement approach from that of other companies (Liker, p. 223).



And, in its full realization, *genchi genbutsu* is far from simply going and seeing. Liker quotes the president of the Toyota Technical Center (TTC), Tadashi Yamashina[30] (p. 224): "It is more than going and seeing. 'What happened? What did you see? What are the issues? What are the problems?'" To practice what Toyota calls "deep" *genchi genbutsu* requires years of training and practice, and is expected of all employees. The practice entails not just observing the situation but analyzing it in terms of what problems might exist and what might be their causes based on your knowledge and experience. This need to have sufficient prerequisite knowledge and experience is why acquiring the ability to practice really "deep" *genchi genbutsu* may take years to acquire.

All this is not to say data doesn't have its palace, but data alone will usually not tell the whole story and should be used with *genchi genbutsu*, not in place of it. An example of this in Liker is a story told by David Baxter, a vice president at TTC[30]. One of his early assignments was visiting a testing lab Toyota was thinking about using. The purpose of the visit was to see exactly how that lab carried out the testing by giving them a sample test that had already been run by Toyota. According to Baxter, they got the "right answer" but by doing *genchi genbutsu*, Toyota found out the lab wasn't doing the test to Toyota standards. Had Toyota simply accepted the results data without going to the lab it would have said this lab's OK even though the test was not up to Toyota's high standards.

A simpler example of *genchi genbutsu* related by Liker is the major redesign

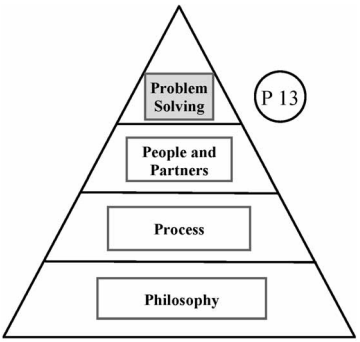
30) At least at the time Liker's book came out.

of the Sienna minivan in 2004. Since it was targeted at the U.S., Canada, and Mexico, the chief engineer on this project, Yuji Yokoya, decided to go and see for himself just what it was like to drive such a vehicle in those places. In fact his goal was to drive in every U.S. state and in Canada and Mexico. As Liker relates it:

> Yokoya achieved his goal of driving in every single U.S. state, including Alaska and Hawaii, and every part of Canada and Mexico. In most cases they[31] were able to rent a Toyota Sienna, looking for ways to improve it. As a result, he made many design changes that would make no sense to a Japanese engineer living in Japan.

For example improving "drift" control due to the roads in Canada having a higher crown than those in America, and incorporating a flip-up tray the driver can use to hold food since Americans often eat in their cars as opposed to the Japanese who usually stop to eat.

Liker gives several other examples of *genchi genbutsu*, but the bottom line is you can't really fully appreciate what's going on, be it a specific problem that's cropped up or the day-by-day operation for which you are responsible, without going to the scene and seeing for yourself—and that "seeing" should be based on already knowing enough to recognize any problems and what their causes might be. It also means taking nothing for granted and not relying on the reports of others (although they should be taken into account).



Principle 13: Make decision slowly by consensus, thoroughly considering all options; implement decisions quickly. Alex

31) An American program manager from TTC assisted him.

Warren, a former Toyota Motor Manufacturing, Kentucky VP, contrasts the way Toyota makes decisions with the way they are made in a typical American company. Say there's a project that is to be fully implemented in a year. The American company will begin implementing in three months but spend the rest of the year correcting problems.

> Toyota will spend nine to 10 months planning, then implement in a small way—such as with pilot production—and be fully implemented at the end of the year, with virtually no remaining problems. (Warren quoted in Liker, p. 237)

It is another case of Toyota believing in the wisdom of the slow but steady approach of the "tortoise" versus the herky-jerky approach of the "hare."

According to Liker there are five major elements to Toyota's decision making:

- Find out what's really going on—the situation—including the use of *genchi genbutsu*.
- Fully understand the problem (e.g., by asking "why" five times).
- Consider all possible alternatives and develop a rationale for the preferred one.
- Build consensus with all possible stakeholders both inside and outside of Toyota.
- Use very efficient communications to accomplish the first four elements.

We've already covered the importance of understanding the situation in Principle 12, and Principle 14 will address the second element. The third element is paradoxical in a way since Toyota is famous for it ability to develop a car faster than anyone yet its engineers are trained to take the time "to think in sets of alternative solutions" (p. 240) which include not only the engineering of the car but the manufacturing system needed to make it.[32] Liker notes some examples from

32) Called "set-based concurrent engineering."

the tightly scheduled Prius development; for example, the hybrid engine technology started with 80 different alternative approaches that were eventually narrowed down to ten and then four. These four were then carefully evaluated resulting in a final solution that was confidently selected as the best. The point is that all this takes time but, in the end, results in faster developments since all the details have been worked out beforehand for a sound final decision.

Another thing that contributes to a smoother and speedier implementation once the decision is made is *nemawashi*. *Nemawashi* is common in Japan and means discussing a decision with all concerned *before* the decision is made to get consensus (the fourth element). Often these discussions will be informal but a formal request for a proposal to be reviewed could also be part of the *nemawashi* process. With Toyota the purpose of *nemawashi* is twofold: to not only get the person's agreement but, even more important, to see if that person has something to contribute that will result in a better decision. And it is important not to leave anyone out who could have an interest in the decision. This is pointed out in a quote on page 248 of Liker:

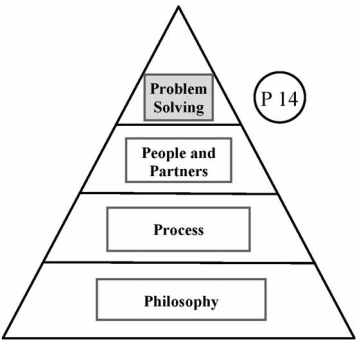
> For some decisions I may think I already know the answer and do not need input from others. There may be a department that is not directly involved and I think they probably do not have much to contribute. I may in fact find the right answer on my own, but I will have a hard time presenting it because the group I skipped will challenge my recommendations… (Andy Lund, PM for 2004 Sienna)

The fifth element means communicating in a clear and concise way to accomplish the other four elements. Toyota has come up with what it calls the A3 report. The idea is to place all relevant information about a decision to be made on an A3 size sheet (297 × 420 mm). In American terms this would be about the size of two letter-size sheets side by side. This may seem very restrictive since we think of a typical company report outlining a major decision as consisting of

many pages in a loose-leaf binder. However such a format also means those who must "sign off" on it will have to take a lot of time to digest all those pages or, worse yet, give it a perfunctory look since "they simply didn't have the time to read it all."

Restricting the size of the decision paper to an A3 size also forces the action person to understand the situation/problem so well he or she can get everything important down on one sheet. Figure 19-2 on page 245 in Liker shows an actual A3 report and what is probably a typical presentation format: *current situation*, *proposal*, *labor cost & time analysis*, *plan*, *implementation*, *controls*, and *timeline*. Indeed, if all these points have been thoroughly addressed and fully co-ordinated through *nemawashi*, it is likely the final decision will go quickly and smoothly. In fact Liker says the Figure 19-2 proposal was given final approval in less than five minutes at the executive board meeting.

In sum, Toyota's way of making decisions ensures all possible alternatives have been considered, ensures all potential interests are heard from and, sort of serendipitously, contributes to Toyota's goal of being a true learning organization since all the work that must happen before the decision requires a lot of learning to take place. And this brings us to the last of the fourteen principles: becoming a learning organization.



*Principle 14: Become a learning organization through relentless reflection (*hansei*) and continuous improvement (*kaizen*).* It is probably with good reason Liker lists this principle last because becoming such an organization must surely be the ultimate accomplishment[33]. When

33) Akin to an individual getting to the top of Maslow's hierarchy: *self-actualization.*

Peter Senge wrote about the idea of a "learning organization" in his famous book, *The Fifth Discipline*, in 1990 it was considered a breakthrough in thinking. However, as far as Toyota is concerned, it was nothing new. The key to becoming a learning organization is "learning how to learn" and Toyota seems to have this down pretty well. An old truism is we learn by our mistakes and this is the basis for much of the learning that goes on in Toyota and why "relentless reflection" or *hansei* is part of the Toyota culture.

Hansei means to continually be looking for the weaknesses in what you're doing, be it some process you're responsible for or a program you're running. And by doing *hansei*, your ultimate goal is continual improvement (*kaizen*). Liker quotes Bruce Brownlee, a general manager at the Toyota Technical Center[34]:

> *Hansei* is really much deeper than reflection. It is really being honest about your own weaknesses. If you are talking about only your strengths, your are bragging. If you are recognizing your weaknesses with sincerity, it is a high level of strength. But it does not end there. How do you change to overcome those weaknesses? That is at the root of the very notion of *kaizen*.

And, as Liker points out, it is not easy for Americans to accept this essentially Japanese cultural trait. In a traditional American program review setting the program manager would expect to be praised for all his or her hard work. At Toyota the emphasis is not so much on what went right but what are the weaknesses in the program and how can they be overcome? Of course the idea is not to belittle a person's efforts but to improve things; however, initially anyway, an American might take it as the former.

The ideal is to establish this *hansei* mindset in every employee so this continual reflection on what's being done in terms of how it can be improved becomes second nature.

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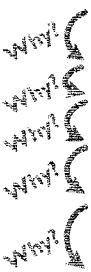
34) At least at the time the book was published.

Closely related to *hansei* is Toyota's attention to problem solving and training its people in it. We've already discussed this under the last principle about the elements for making good decisions. For example, a lot of time is spent in understanding the true situation/problem including using *genchi genbutsu*. Once the problem is well understood then the "five whys" are asked. This means asking "why" five or more times as you progress back towards a root cause. Liker illustrates this with an example from Scholtes (Figure 10). Note that with each "why" more and more information is gained about some weakness in the process or organization until a root cause is revealed for which an effective countermeasure can be developed. By doing all this not only is the problem being solved but a great deal of learning is taking place.



Level of Problem	Corresponding Level of Countermeasure
There is a puddle of oil on the shop floor	Clean up the oil
Because the machine is leaking oil	Fix the machine
Because the gasket has deteriorated	Replace the gasket
Because we bought gaskets made of inferior material	Change gasket specifications
Because we got a good deal (price) on those gaskets	Change purchasing policies
Because the purchasing agent gets evaluated on short-term cost savings	Change the evaluation policy for purchasing agents

Figure 10. An example of a "5-Whys" investigation (Liker, p. 253 from Scholtes, 1998)

Another important element of creating a learning organization is Toyota's emphasis on standardization as discussed under Principle 6. Without it very little learning can occur since there will never be the stability needed to move to the next higher level of excellence. Very generally and in terms of the Deming PDCA cycle Toyota does this by (1) making a *plan* to improve a process by changing it to create more flow (Principle 2), (2) introducing the change (the *do*

step) which will usually surface problems, *checking* these problems and developing countermeasures, and finally, *enacting* the countermeasures.[35] Once the process with improved flow is stabilized, the cycle is repeated.

Perhaps one of the most important ways Toyota promotes learning is its use of *hoshin kanri*, also known as policy deployment. It is a way to not only promote learning and improvement but to ensure everyone in the organization is on the same page. At the top of the organization quantified goals are developed that are then "deployed" down the chain so each manager and even individual team members have quantified supporting goals. Liker tells of meeting with a group leader who was able to immediately show him his goals for the day. And these are not just any goals but usually challenging stretch goals that, in effect, force learning to take place.

A final word about Toyota as a learning organization: Toyota is process-oriented. Most companies are results-oriented; that is, focused on how much they can make or sell or how much money they can make in a quarter. Toyota's emphasis on learning is in terms of *how to improve its processes* be they for making a Camry or developing the next concept car. With good processes Toyota knows the results will follow and surely that's being proven true today.

4. Summary and Conclusion

Starting with the values Sakichi Toyoda learned from his father and continuing with the preservation, enhancement, and passing on of those values right up to the present day, Toyota has become one of the most successful, admired, and imitated companies in the world. Appendix D is a good summary of those values as Toyota sees and practices them today. Throughout its history Toyota has had to overcome many problems. Not only has Toyota been able to do this, it has also

35) Note, this is a slightly different view of this cycle from Liker's on page 264.

shown it can radically innovate as demonstrated with its Lexus and Prius developments. Toyota is expected to soon be the number one producer of cars in the world, and this at a time when former powerhouses such as GM and Ford are struggling to survive. What is it about the way Toyota operates that sets it apart to be so successful? *It is its values*, and the specifics of how those values are actually practiced are what Liker has tried to describe in his book on the 14 Principles. The purpose of this paper has been to first describe Toyota by briefly telling its history and then summarize Liker's 14 Principles.

Probably the most important message Liker wishes to convey is that it is not simply the Toyota Production System (TPS) that accounts for Toyota's success but something bigger called the Toyota Way. This is what the 14 Principles, in effect, describe. Probably the reason so many companies that try to imitate Toyota never achieve its level of performance is they, either consciously or not, have failed to develop a culture essentially based on the Toyota Way. Unless you are thinking long-term, developing your people, and striving to truly become a learning organization, practicing the TPS is only working at a surface level and will never result in true excellence. In fact, as companies often find, it becomes very difficult to sustain a good lean TPS-like operation without a change in their culture, *and that's the really hard part*.

Towards this end, Liker finishes his book with two chapters on "applying the Toyota Way to our organization." He has also co-authored a "fieldbook" (Liker & Meier, 2006) to provide even more guidance to those interested in seriously pursuing such a cultural change.

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Appendix A

Partial List of Firms Established By Toyota

(History of Toyota, 2006)

Firm	Year Established
Toyoda Seiko, Ltd. (currently Aichi Steel Works, Ltd.)	1940
Toyoda Physical and Chemical Research Institute	1940
Toyota Machine Works Co., Ltd.	1941
Tokai Hikoki Co., Ltd. (currently Aisin Seiki Co., Ltd.)	1943
Toyota Shatai Kogyo Co., Ltd. (currently Toyota Auto Body Co., Ltd.)	1945
Kanto Electric Auto Manufacturing, Ltd. (currently Kanto Auto Works, Ltd.)	1946
Nisshin Tsusho Co., Ltd. (currently Toyota Tsusho Corporation)	1948
Nagoya Rubber Co., Ltd. (currently Toyoda Gosei Co., Ltd.)	1949
Nippondenso Co., Ltd. (currently Denso Corporation)	1949
Toyota Motor Sales Co., Ltd.	1950
Minsei Spinning Co., Ltd. (currently Toyoda Boshoku Corporation)	1950
Towa Real Estate Co., Ltd. established	1953
Toyota Motor Sales, U.S.A., Inc.	1957
Toyota Central Research & Development Laboratories, Inc.	1960
Calty Design Research, Inc. (in Newport Beach, California)	1973
Toyota Technical Center U.S.A., Inc. (in Ann Arbor, Michigan)	1977

Note: Toyota has established many other firms. This is just a representative sample to emphasize how Toyota used (and continues to use) this technique for enhancing its core operations.

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Deming's Fourteen Points

(Deming, 1986, pp. 23–24)

Point 1: Create constancy of purpose towards improvement of product and service, with the aim to become competitive and to stay in business, and to provide jobs. Here Deming is stressing the need for management to make a real commitment to quality so that everyone else in the company has confidence *that there will be a future*. Specifically, management must innovate, put resources in research and education, and "constantly improve the design of product and service." Management must be concerned with business far beyond the next quarter's dividends!

Point 2: Adopt the new philosophy. We are in a new economic age. Western management must awaken to the challenge, must learn their responsibilities, and take on leadership for change. According to Deming, for the transformation (of Western management) to occur: "We can no longer tolerate commonly accepted levels of mistakes, defects, material not suited for the job, people on the job that do not know what the job is and are afraid to ask..." (p. 26). Citing the precision with which the Japanese train system operates—as opposed to what we often find in America or Europe, for example—Deming relates this set of instructions for getting to a company in Japan: "0903 h Board the train. Pay no attention to trains at 0858, 0901. 0957 h Off."

Point 3: Cease reliance on mass inspection to achieve quality. Eliminate the need for inspection on a mass basis by building quality into the product in the first place. The main idea here is that it is better to randomly sample the process's output for purposes of maintaining statistical quality control rather than having 100% inspection. Deming mentions a printing company that had prided itself on proofreading everything eleven times yet still needed help due to constant customer complaints. The problem: each of the eleven inspectors relied on the other ten! In other words: you can't inspect quality into a product or service. Instead, you should work to constantly improve the process—improved quality will automatically result.

Point 4: End the practice of awarding business on the basis of price tag. Instead, minimize total cost. Move toward a single supplier for any one item, on a long-term relationship of loyalty and trust. Deming quotes from an actual government advertisement for professional help: "For delivery and evaluation of a course on management for quality control for supervisors... An order will be issued *on the basis of price*." Worse yet, such a practice will drive those who

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Deming's Fourteen Points

would have delivered good products and services out of business. Common sense tells us that you can't make quality products out of poor quality material. The other idea contained in this point is that it is a good idea to establish long-term relationships with your suppliers. This way you can work together to improve the quality of the supplies and, accordingly, that of the product in which they are used. As the product's quality improves and it becomes more successful, the additional profit can be shared with the supplier thus encouraging further improvements!

Point 5: Improve constantly and forever the system of production and service, to improve quality and productivity, and thus constantly decrease costs. Some of the things Deming mentions here are continual improvement through a better understanding of customer requirements, development of better relationships with suppliers, doing a better job of hiring, training, and supporting workers, and considering/experimenting with all ways that a process might be made better (maybe just by changing the temperature or humidity).

Point 6: Institute training on the job. Deming cites an example, perhaps all too common, of a worker simply being told to "go to work" without having the job explained to him and, to make matters worse, a foreman who "knows nothing." Managers need to be trained in all aspects of the company operation and given an appreciation of variation. Unfortunately, most American managers have not had experience at the "factory floor" level. Deming also brings up the importance of recognizing that people learn in different ways.

Point 7: Institute leadership. The aim of supervision should be to help people and machines and gadgets to do a better job. Supervision of management is in need of overhaul, as well as supervision of production workers. Deming here is saying the job of management is not "passive" supervision but "leadership" supervision. This means knowing enough about the worker's job to be able to give him or her the help needed. It also means not managing by the numbers as in "zero defects" or just meeting or not meeting some specification. The goal of leadership should be to empower (with the training and equipment needed) and encourage the worker to continually improve the process, not meet some relatively arbitrary specification or make some quota number.

Point 8: Drive out fear, so that everyone may work effectively for the company. Workers and supervisors will often do what management wants out of fear, even

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Deming's Fourteen Points

if it has long-term adverse consequences. One example Deming cites is a foreman who knew the production line needed to be shut down for repairs but took a chance in an attempt to meet management's quota for castings. When his worst fears were realized, not only wasn't the quota met, but also the line was down for four days for repairs! Fear will lead to such things as an inspector passing poor quality products and fudging figures. A secure environment must be created where the worker knows it is OK to report a problem and where a spirit of working together to solve problems prevails over blaming.

Point 9: Break down barriers between departments. People in research, design, sales, and production must work as a team, to foresee problems of production and in use that may be encountered with the product or service. Another common problem in companies is the left hand not knowing what the right hand is doing. Deming gives the example of a perennial design problem that the servicemen continued to correct because there was no system for feedback to manufacturing to eliminate the problem in the first place! Departments need to think in terms of who their internal customers are and develop a good working relationship with them.

Point 10: Eliminate slogans, exhortations, and targets for the work force asking for zero defects and new levels of productivity. Such exhortations only create adversarial relationships, since the bulk of the causes of low quality and low productivity belong to the system and thus lie beyond the power of the work force. What good are slogans when nothing is changed to help the worker do a better job? Deming's famous Red Bead experiment dramatically demonstrates the futility of exhorting workers to do better when the system remains the same. As the experiment shows, the (management created) system will never allow the workers to do better until management changes it.

Point 11a: Eliminate work standards (quotas) on the factory floor. Substitute leadership.

Point 11b: Eliminate management by objectives. Eliminate management by the numbers, numerical goals. Substitute leadership. As Deming so eloquently points out, work standards (quotas) are great demoralizers. Take the case of the woman required to handle 25 reservation/information calls an hour for some airline. Due to circumstances beyond her control, calls often took longer than the average of 1/25 of an hour (2.4 minutes) the standard called for. The result was a dilemma: either give courteous and helpful service or rush the call, often angering the cus-

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Deming's Fourteen Points

tomer. Instead the process must be studied and systematically improved.

As for management by the numbers, the main problem is saying "we will increase productive (or anything) by, say, 10% next year" *without a plan or method for doing so*. It's as if somehow that increase will occur without any change in the way the company has been doing business—impossible, with a lot of frustration being the only result.

Point 12a: Remove barriers that rob the hourly workers of their right to pride of workmanship. The responsibility of supervisors must be changed from mere numbers to quality.

Point 12b: Remove barriers that rob people in management and in engineering of their right to pride of workmanship. This means, inter alia, abolishment of the annual review or merit rating and of management by objectives. Some of the barriers to pride of workmanship cited by Deming in *Out of the Crisis* are: foremen who are afraid to make decisions or don't know their job well enough to give leadership, equipment not working right, inadequate training, and being required to use poor quality materials. Deming cites many real-life examples.

Point 12b, about eliminating the annual review or merit rating, is perhaps the only point that is controversial. However, Deming's basis for this point is similar to that for Point 3, Cease reliance on mass inspection. As Deming puts it:

> Basically what is wrong is that the performance appraisal or merit rating focuses on the end product, at the end of the stream, not on leadership to help people. *This is the way to avoid the problem of people*. A manager becomes, in effect, manager of defects [emphasis added]. (p. 102)

Besides this, such rating systems tend to foster competition among workers rather than teamwork. They also tend to foster an attitude of "not rocking the boat" and focusing more on how to get a good rating (e.g., tell the boss what he/she wants to hear) rather than using the knowledge possessed to help the company.

Instead, Deming says the performance of all workers doing a similar job should be tracked and plotted on a control chart. Should anyone's performance fall outside reasonable limits, an investigation should be conducted to determine the cause (inadequate training, bad equipment, etc.). It is usually the system, not the individual worker that is at fault when something goes wrong or there is poor performance. In fact, according to Scholtes, et al. (1996, p. A-4), about 85 percent of the problems an organization encounters are due to the system. Given that you have been careful to select good people, given them appropriate training and the chance to gain experience, and provided motivation, they will almost invari-

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Deming's Fourteen Points

able do a good job *if the system lets them.*

Point 13: Institute a vigorous program of education and self-improvement. As opposed to Point 6, *Institute training on the job*, this one is talking about just making your people better through education and other means such as giving them additional responsibilities. To quote Deming from *Out of the Crisis*: "People require in their careers, more than money, ever-broadening opportunities to add something to society, materially and otherwise" (p. 86).

Point 14: Put everybody in the company to work to accomplish the transformation. The transformation is everybody's job. This simply means moving beyond words to action. Management must study, understand, and agree on what the other 13 points mean and then disseminate this information to all the others in the company and develop concrete plans for accomplishing the points with *everyone's* involvement.

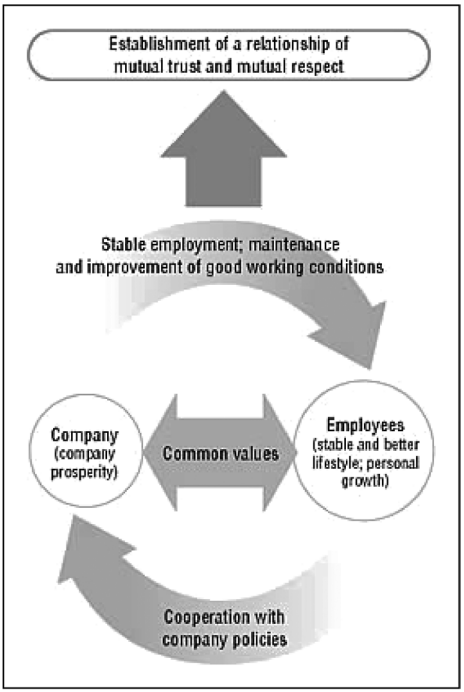
Appendix C

Mutual Trust Between Labor and Management

(Toyota Environmental & Social Report 2003, under Social and Economic Aspects, Employees)

The basic concepts of mutual trust between labor and management are: improvements in the lives of employees are realized through the prosperity of the company, and labor and management thus share the same goal of company prosperity as a common value; management will take into consideration to the greatest possible extent stable employment and will continuously strive to improve working conditions; and employees will cooperate with the company's policies in order to promote the company's prosperity.

In the Labor and Management Resolutions for the 21st Century signed by labor and management representatives in 1996, mutual respect was added to mutual trust as a foundation of labor-management relations, and this is reflected in the current Guiding Principles at Toyota Motor Corporation. (Below is Toyota's view of the "mutual trust between labor and management.")



Appendix D

Guiding Principles at Toyota*

(Guiding Principles, 2006)

1. Honor the language and spirit of the law of every nation and undertake open and fair corporate activities to be a good corporate citizen of the world.
2. Respect the culture and customs of every nation and contribute to economic and social development through corporate activities in the communities.
3. Dedicate ourselves to providing clean and safe products and to enhancing the quality of life everywhere through all our activities.
4. Create and develop advanced technologies and provide outstanding products and services that fulfill the needs of customers worldwide.
5. Foster a corporate culture that enhances individual creativity and teamwork value, while honoring mutual trust and respect between labor and management.
6. Pursue growth in harmony with the global community through innovative management.
7. Work with business partners in research and creation to achieve stable, long-term growth and mutual benefits, while keeping ourselves open to new partnerships.

*Adopted in 1992