Toyota Production System

1945 · 1950 · 1955 · 1960 · 1965 · 1970 · 1975 · 1980

Needs of the time

Productivity improvement and effective utilization of materials

In the face of the post-war material shortage and small production volume, it was necessary to raise the productivity level to that achievable in large-volume production and to produce only as many items as required by effectively utilizing materials.

Facility modernization and production efficiency improvement

Toyota learned a painful lesson from the massive layoff resulting from the recession caused by the Dodge Line. Therefore, even when its production volume began to expand, due to the special procurement boom for the Korean War, Toyota tried to refrain from hiring more people. Instead, it promoted mechanization and a conveyor belt system to produce only those items absolutely necessary.

Establishment of mass production system

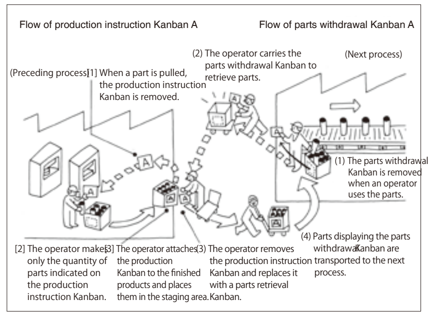
In response to spreading motorization, productivity was dramatically improving through the introduction of high-speed heavy machines and division of labor, making it important to produce high-quality products on a just-in-time basis. With the trigger of an oil crisis, it became essential to build a structure whose productivity would not drop, even when production volume declined.

Just-in-time production system

- Pull system of production
- Transporting only what is needed
- Producing products within a flow
- Producing products in small lots
- Production leveling based on takt time

Pull system of production adopted (1948)

Fill-up system of production adopted at machining plants (1954)



Modeling after the supermarket system

• A supermarket is a convenient store where you can buy what you need when you want. Customers do not need buy any unwanted items, while the store only needs to replenish what has been sold, resulting in no waste for either party.

• Using this system as a model, Toyota established a system in which the operator goes from the location where parts will be used (next process) back to where the parts were made (preceding process), in order to retrieve only the necessary parts at the right time. ------ Pull system of production
Then, Toyota began to use transport cards (parts withdrawal Kanbans) when retrieving parts.
• Furthermore, at the production location, a specified number of completed parts are kept in a designated area, and only as those parts are retrieved are they replenished. ----------------- Fill-up system of production
Then, Toyota began to use production cards (production instruction Kanbans) to control inventory and production.
• Toyota introduced this system first into its machining plants and subsequently expanded it to other processes. After implementing various types of improvements to cope with machine breakdowns and defective products, Toyota learned to produce and transfer only the required products, in only the required quantity, only when required.

Elimination of intermediate warehouse (1954)

Toyota proceeded to make improvements such as implementing the pull and fill-up systems of production, and was thereby able to eliminate intermediate warehouses such as the finished product maintenance room provided between the machining and assembly processes and the intermediate maintenance room provided between the stamping and assembly processes, further reducing inventory.

Adoption of a conveyance call-out system in machining plants (1953)

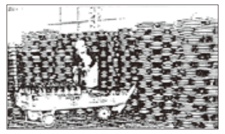
In order to transfer only the required materials in only the required quantities only when required, and to improve delivery conveyance, Toyota adopted a system in the machining plant in which materials are delivered based on a call-out from the next process using a light signal.

Adoption of a relay system for delivering materials between plants (1959)

Toyota adopted a system that divides the delivery process into truck driving and truck loading/unloading. In this system, a truck driver arriving at a destination switches to another truck that has already been loaded/unloaded and departs, thereby improving logistics efficiency.

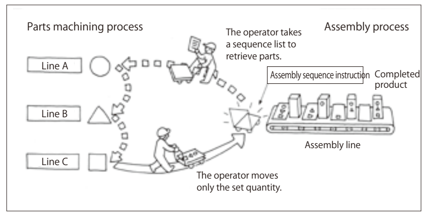
Adoption of a system to take delivery of parts in set quantities (1955)

Whereas parts were previously delivered in bulk and stored, Toyota switched to a system in which pre-specified quantities of parts were loaded on pallets and delivered to the work site in pallet increments, eliminating the intermediate accumulation of stock.



Parts loaded in bulk

Adoption of set quantity delivery (1955)



In the set-quantity delivery system, the operator retrieves only the set quantities of required parts according to the production sequence specified in the assembly process. Adopting this system synchronized the assembly and parts machining processes, allowing both to carry out lean production with low inventory.

Adoption of sequence tables (1957)

Rather than using a mass production system that managed vehicle production in a specified number of lots, sequence tables indicating the production sequence for individual vehicles were distributed. Component assembly and vehicle assembly processes were then carried out according that sequence, producing only the required parts and vehicles.

Adoption of a system that issues production instructions on a just-in-time basis (1960)

Since production instructions based on sequence tables do not show the progress status of individual processes, production in the individual processes may be too fast or too slow. Therefore, Toyota adopted a system that uses an ÒInter-writerÓ, etc. to issue production instructions on a just-in-time basis

Promotion of synchronization among various processes (1950s)

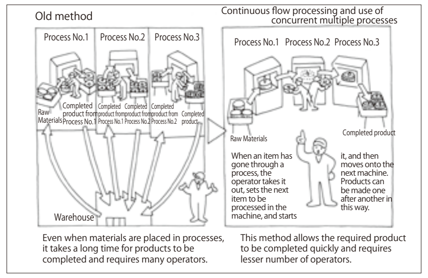
Vehicle production involves many continuous processes, such as the machining process and the assembly process or the body plant and the assembly process. Toyota made it possible for the preceding process to know the progress of the next process, so that production on the two processes can be synchronized.

Complete elimination of picking tickets (1960)

The system of issuing parts picking tickets whenever a part was picked was changed in 1955 to one that issues only monthly reports. Furthermore, as the pull and fill-up production systems were expanded, reducing inventory, Toyota completely eliminated picking tickets.

Adoption of continuous flow production (1963)

Adoption of concurrent multiple processes (1963)



Continuous flow

Previously, after parts had gone through a process, they were placed in a warehouse and later taken out to be processed in the next process. With the continuous flow system, machines were instead arranged according to the processing sequence and parts were sequentially machined one by one starting from the raw material. This new method allowed the necessary parts to be completed within a short period of time.

Use of concurrent multiple processes

In the continuous flow process, a machine stops once processing is finished. The operator removes the completed item and sets the next item to be processed in the machine. In addition, the operator carries the processed item to the next machine and repeats the same routine there. As a result, items no longer stagnate and can be finished more quickly. Training is also provided to help each handle take charge of multiple machines (processes), resulting in higher efficiency.

Adoption of a red/blue-tag system for accepting deliveries of parts from outside suppliers (1961)

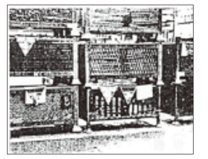
Toyota initially tried this system before the Kanban system, which was adopted in order to procure parts on a just-in-time basis. A red tag was issued when 10% more parts than planned were required, and a blue tag was issued when 10% fewer parts than planned were required

Adoption of the 10-day order system (1966)

To cope with an increasing number of different specifications, Toyota switched from monthly production planning to 10-day production planning (receiving orders three times a month). As a result, the number of days it took from order receipt to vehicle delivery was halved from an average of 50 days to 25 days.

Company-wide adoption of the Kanban system (1963)

A plan was developed to propagate the Kanban system, which had started in the Machining Division, throughout the entire company. The system was gradually expanded with many trials and errors occurring in individual processes, until it was eventually adopted in nearly all processes.



Pallet with Kanban

Adoption of the Kanban system for parts supplied from suppliers (1965)

In order to eliminate emergency deliveries and excess inventory and to facilitate delivery of parts on more of a just-in-time basis, the Kanban system, which had involved some suppliers starting in 1963, was expanded to all suppliers.

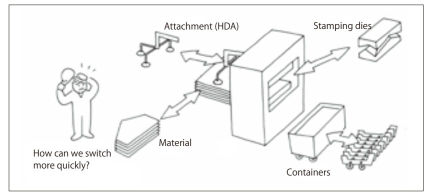
Expansion of the conveyance call-out system to all plants (1970)

To supply parts on a just-in-time basis and improve conveyance efficiency, the conveyance call-out system, which had first been adopted for conveying materials at the Honsha Plant machining plant, was expanded throughout the entire company.

Adoption of the relay system for suppliers trucks (1973)

The relay system adopted for delivery materials between plants was also applied to transfers involving parts suppliers and body manufacturers.

Shortening of time for changing stamping setup at all plants (1971)



In the stamping process, several types of parts are produced on a single line. However, for each different part, the setup must be changed, including the stamping dies, material, container, jigs, and tools. Through many improvements, Toyota was able to shorten the setup switching time to less than 10 minutes and produce small quantities of various parts in the exact quantities needed. The new system made stable production possible with only low inventory and also reduced waste in storage and

Development of various types of simple automated machines to facilitate continuous flow production (1975)

Flow production was achieved through various innovative steps. In two examples, the painting of parts, previously done in batches using large-scale equipment, was switched to line-by-line painting using simple painting machines, and a simple machine was provided in the next process to sort previously stamped parts into those with holes and those without holes.

Adoption of the daily order system (1970)

In response to the introduction of the full choice system, Toyota switched to a system that fixed customers by order the 10-day plan one day at a time. The new system allowed plan changes even five days before a line-off and shortened the delivery lead time to 10 days.

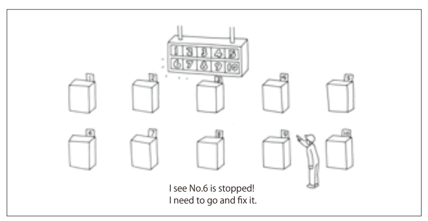
Jidoka

- When a problem is detected, production lines stop and an alert is displayed
- Separation of operatorsÕ work and machinesÕ work

Assignment of each operator to multiple machines begins (1947 through 1950)

To reduce the muda associated with assigning each operator to a single machine when the required volume was small and to improve productivity, machines were positioned in parallel or in an L-shape and each operator was assigned to multiple machines.

Adoption of andon system for visual control (1950)



Innovation in machining process automation (1951)

Innovative measures, such as setting up machines to be automatically fed or stopped by a limit switch when processing was completed, made it possible for operators to safely leave active machines. This in turn enabled the assignment of each operator to multiple machines.

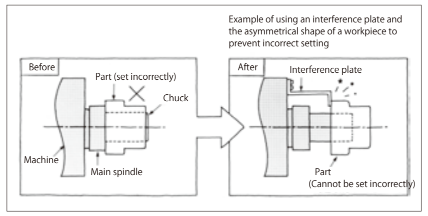
Establishment of standardized work (1953)

Toyota established standard operations consisting of specified takt times, work sequences, and standard amounts of work-in-process on hand to achieve an efficient production system. Machines and materials were positioned intelligently, taking operator movement into consideration.

Adoption of andons linked to a stop button (1955)

In order to easily identify the process that had caused a line stoppage, Toyota adopted stop-button-linked andons on the Crown assembly line at the Honsha Plant.

Building in quality through the use of Poka-yoke (mistake proofing) (1962)



Adoption of full - work control (1962)

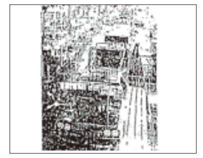
To avoid making unnecessary items on lines linked through the automated transport system, Toyota used the Kanban concept to establish and electrically control the conditions required to send a processed item to the next process.

Completion of an automated engine line (1966)

An M-type engine line equipped with high-performance equipment and an automated transport system was completed at the Kamigo Plant. Adopting a system that stopped the equipment when a problem was detected, along with andons that displayed the problem location, enabled Toyota to efficiently produce only high-quality products.

Adoption of a system of fixed Ð position Ð stop in the assembly process (1971)

After clearly identifying the work scope within each process, the line was designed to stop at a fixed position if a problem could not be corrected within the scope of a particular process. This system prevented defective products from being sent on to the next process.



1985 1990 1995 2000 2005

Handling of demand fluctuation and diversification, and locating plants in multiple regions

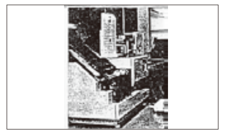
As the market matured, demand fluctuation and diversification widened and plants were being established in many locations inside and outside Japan. It became important to establish a production system that included parts suppliers to flexibly meet the requirements of the just-in-time system.

Coping with globalization

Based on its philosophy of Ôproducing vehicles where they are soldÕ, Toyota rapidly expanded production overseas, including China, other Asian countries, and the EU. It implemented global initiatives in order to deliver vehicles to overseas customers at the same quality, lead time, and productivity levels as in Japan.

Adoption of automatic kanban reading machines (1977)

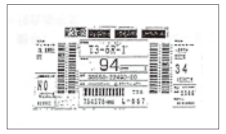
As the number of types of parts and their volume increased, Toyota installed automated Kanban readers to simplify the handling of kanbans and the clerical processing involved, and to improve accuracy in keeping track of the number of times kanbans were used.



Automated kanban reader

Adoption of electronic Kanbans for long distance suppliers (1993)

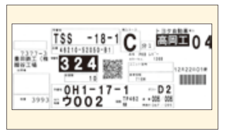
To prevent Kanban information transmission time from becoming longer as plants were built at distant locations, Toyota began to electronically send parts retrieval Kanbans to preceding processes, thereby shortening lead times.



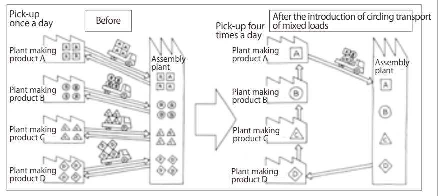
Electronic Kanban

Adoption of the e-Kanban system (1999)

Toyota further evolved the electronic Kanban system and adopted the e-Kanban system, which transmitted information for ordering necessary parts based on confirmed vehicle sequence information and made automatic adjustments to the number of Kanbans for each month.



Adoption of circling transport of mixed loads (1977)



Previously, when loads from several parts plants were small and picked up by multiple trucks, parts could only be picked up once a day as shown on the left. A shift to circling the multiple plants with a single truck that collected the parts and transported them in a mixed load, as shown on the right, made it possible to supply parts more frequently (four times a day in this case), without degrading logistics efficiency. As a result, both of the parts plants and the assembly plant were able to carry on production with lesser inventories.

Shortening lead time by reassessing logistics (1983)

As Toyota Motor and Toyota Motor Sales were merged, duplicate processes and inspection steps were eliminated, and production and logistics were synchronized, establishing a smooth and efficient flow from order receiving to production and to logistics, thereby shortening lead time.

Adoption of combined marine and land transport for remote locations (1996)

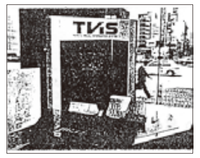
Toyota adopted a transport system that consolidated parts destined for remote locations such as Kyushu and used marine and land transport for all shipments, thereby achieving both cost reduction and shorter lead times.

Adoption of joint transport of completed vehicles (1998)

Transporting other companiesÕ vehicles on the return trips of Toyota vehicle transports from plants to dealers improved transport efficiency and reduced both cost and CO_2 emissions.

Building of the Toyota Network System (1986)

Toyota began using a high-speed digital line to process information on orders, production, and vehicle delivery online on a real-time basis, thereby shortening lead time and improving planning accuracy.



Dealer terminal TVIS

Development of Global Body Line (GBL) (1999)

As overseas production expanded, Toyota implemented a flexible system that made it possible for the various overseas locations to add, switch, or mutually replenish vehicle models. In addition, it developed and propagated a new body welding technology that ensured high quality at all of its plants.

Better production instruction system devised in each process (1971)

To produce multiple vehicle models flexibly on a just-in-time basis, easy-to-follow production instruction methods were devised for each vehicle, including an assembly sticker method and balls for production instruction device for body assembly.

Adoption of a new order system (1974)

Adoption of a system that blended 10-day ordering with daily ordering enabled Toyota to efficiently produce both small- and large-volume vehicle models for sale with a short lead time.

Adoption of automated equipment for issuing production instructions (1980)

Toyota adopted automated equipment such as automated sticker printers, memory devices, monitors, and barcode readers to issue clear production instructions involving diverse specifications on more of a just-in-time basis.

Adoption of the new COMPASS (2002)

Toyota developed a system that stored the times and part installing locations for individual work steps in a database to balance work time among operators and determine the shortest point-to-point walks when a model redesign resulted in changes in production processes.
*COMPASS: Comprehensive Process Planning Assembly Simulation System

*COMPASS=comprehensive process planning assembly simulation system"

Adoption of automated lines using NC machines and robots (1980)

As automated systems, such as computerized NC machines in the machining process and robots in the body process, came into wider use, Toyota incorporated the concept of Jidoka into these systems, building lines that send only high-quality products on to the next process.

Strengthening the system of building in quality in-process (1982)

Toyota wanted to utilize new production technologies in the most fruitful way possible. Therefore, it expanded its system of building in quality in-process throughout the entire company as part of its comprehensive implementation of fundamentals initiative.

Elimination of water-leak test in assembly plants (1998)

Toyota thoroughly ensured quality in all processes at vehicle plants and eliminated the shower test conducted for all vehicles. Water usage was reduced at plants by 20%.

Establishment of standardized work in all processes (1975)

Following the oil crisis, Toyota reassessed how its products were being produced in order to prevent productivity from falling, even during a period of reduced production volume. As a result, it established standard operations for all processes and thoroughly improved the way its products were produced.

Establishment of an efficient production method for dedicated lines with a small number of operators (1985)

The number of dedicated lines staffed by a small number of operators had risen as the number of items to be produced increased and processes were improved. In response, Toyota established a production method that improved productivity by reducing the number of operators in just-in-time production.

Development of Visual & Virtual Communication (V-Comm) (1996)

By creating three-dimensional (3D) data from design drawings to check for interference and workability, Toyota was able to shorten the period between development and production start and improve productivity and quality.