

## Lean Manufacturing, Just in Time and Kanban: Case Study of Toyota Production System (TPS)

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**Abstract:** In this paper, describes about “Lean Manufacturing, Just In Time and Kanban System Case Study of Toyota Production System (TPS)”. Today, many manufacturing companies must follow the all new technology and tools for efficiently and effectively to present themselves a good competitor in the global economy Lean manufacturing is a efficiency based system on optimizing flow to minimizing the wastage and using advance methods to improve manufacturing system by modified or change pre-existing ideas. Essentially it involves having the right items with the right quality and quantity in the right place at the right time. The Toyota production system is a way to make products, whereas the Kanban system is the way to manage the Just-in-time production method. It is a tool to achieve just-in-time production. The Kanban is sent to the people of the preceding process from the subsequent process. Today, more and more North American firms are considering the JIT approach in response to an ever more competitive environment. It is a way to achieve high velocity manufacturing.

**Keywords:** Lean Manufacturing, Just in Time, Kanban system, Case Study, Toyota Production System.

### I. INTRODUCTION

Lean manufacturing is the basic techniques for improve the production rate with the minimum available resources. This concept is comes out after the World War 2. This manufacturing, an approach that depends greatly on flexibility and workplace organization, is an excellent starting point for companies wanting to take a fresh look at their current manufacturing methods. The basic approach to the “Just-in-Time” (JIT) production system is to reduce product costs through the elimination of waste. In a production facility waste can be defined as defects, stockpiles, queues, idleness and delays. The ability to manage inventory to coincide with market demand or changing product specifications can substantially boost profits and improve a manufacturer’s competitive position by reducing inventories and waste. Just In Time (JIT) is a management philosophy, an integrated approach to optimize the use of a company’s resources, namely, capital, equipment, and labor. The goal of JIT is the total elimination of waste in the manufacturing process. [14]

### II. JUST IN TIME SYSTEM

Just-In-Time (JIT) manufacturing is a Japanese management philosophy applied in manufacturing. Essentially it involves having the right items with the right quality and quantity in the right place at the right time. JIT Manufacturing tries to smooth the flow of materials from the suppliers to the customers, thereby increasing the speed of the manufacturing

process. The objectives of JIT is to change the manufacturing system gradually rather than drastically:

- To be more responsive to customers,
- To have better communication among departments and suppliers,
- To be more flexible
- To achieve better quality,
- To reduce product cost.

### III. JIT ENVIRONMENT

In addition to philosophical concepts, JIT also provides an environment in which products are manufactured in a simpler way.

- Repetitive Manufacturing
- Total Quality Management (TQM)
- Total Productive Maintenance (TPM)
- Total Employee Involvement (TEI)
- Supplier Partnership

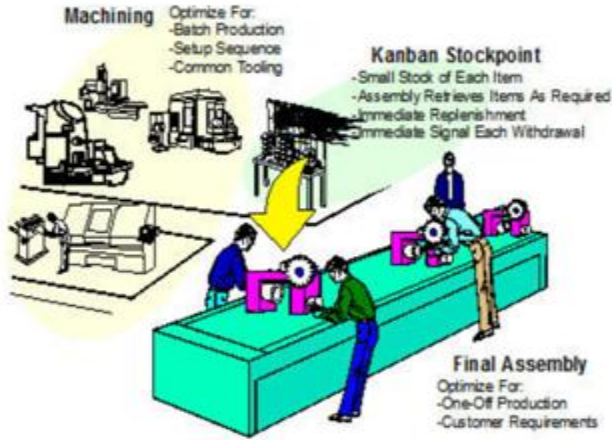
### IV. JIT AS A CONTROL TECHNIQUE

In daily operations, JIT provides useful control methods. The characteristics of a JIT control technique include uniform loading, repetitive processes, pull system, using production cards, and synchronized production.

- Pull System
- Uniform Loading
- Production Card
- Synchronized Production

**V. KANBAN SYSTEM**

Kanban (kahn-bahn) is Japanese word that when translated literally means “visible record” or “visible part”. The kanban system is based on a customer of a part pulling the part from the supplier of that part. The customer of the part can be an actual consumer of a finished product (external) or the production personnel at the succeeding station in a manufacturing facility (internal).

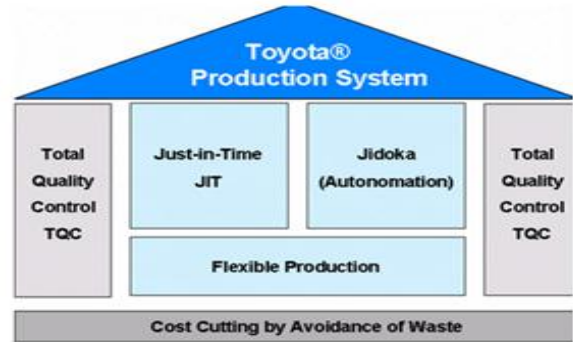


**Figure1. Kanban Manufacture [6]**

**VI. CASE STUDY OF TOYOTA PRODUCTION SYSTEM**

After Second World War, Eiji Toyoda and Taiichi Ohno at the Toyota motor company in Japan pioneered the concept of Toyota Production System. The rise of Japan to its current economic preeminence quickly followed, as other companies and industries copied this remarkable system. Manufacturers around the world are now trying to embrace this innovative system, but they are finding the going rough. The companies that first mastered this system were all headquartered in one country-Japan. However, many methods on the existing mass-production systems cause great pain and dislocation. Toyota Production System is, where it came from, how it really works, and how it can spread to all corners of the globe. Western companies now understand Toyota Production System, and at least one is well along the path of introducing it. Superimposing this for everyone’s mutual benefit. The global adaptation, as it inevitably spreads beyond the auto industry, will change everything in almost every industry-choice of customers, the nature of work, the fortune of companies, and, ultimately, the fate of nations. Perhaps the best way to describe this innovative production system is to contrast it with craft production and mass production, the two other methods humans have devised to make things.[17] The production system developed by Toyota Motor Corporation to provide best quality, lowest cost, and shortest lead time through the elimination of waste. TPS is comprised of two pillars, just-in-time and jidoka, and often is illustrated with the “house” shown at right. TPS is maintained and improved through iterations of standardized work and kaizen. Development of TPS is credited to Taiichi Ohno, Toyota’s chief of production in the post-WW II period. Beginning in machining operations and spreading from there, Ohno led the development of TPS at Toyota

throughout the 1950s and 1960s, and the dissemination to the supply base through the 1960s and 1970s. Outside Japan, dissemination began in earnest with the creation of the Toyota- General Motors joint venture NUMMI in California in 1984.



**Figure2. House of Toyota Production System [11]**

The concepts of just-in-time (JIT) and jidoka both have their roots in the prewar period. Sakichi Toyoda, founder of the Toyota group of companies, invented the concept of jidoka in the early 20th Century by incorporating a device on his automatic looms that would stop the loom from operating whenever a thread broke. This enabled great improvements in quality and freed people to do more valuecreating work than simply monitoring machines for quality. Eventually, this simple concept found its way into every machine, every production line, and every Toyota operation. Kiichiro Toyoda, son of Sakichi and founder of the Toyota automobile business, developed the concept of JIT in the 1930s. He decreed that Toyota operations would contain no excess inventory and that Toyota would strive to work in partnership with suppliers to level production. Under Ohno’s leadership, JIT developed into a unique system of material and information flows to control overproduction. Widespread recognition of TPS as the model production system grew rapidly with the publication in 1990 of *The Machine That Changed the World*, the result of five years of research led by the Massachusetts Institute of Technology. The MIT researchers found that TPS was so much more effective and efficient than traditional mass production that it represented a completely new paradigm and coined the term lean production to indicate this radically different approach to production. [11]



**Figure3. Development of Toyota [11]**

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### A. Production Methods

The craft producer uses highly skilled workers and a simple but flexible tool to make exactly what the customer asks for one item at a time. Few exotic sports cars provide current days obvious: Goods produced by the craft method—as automobiles once were exclusively—cost too much for most of us to afford. So mass production was developed at the beginning of the twentieth century as an alternative.[17] The mass-producer uses narrowly skilled professionals to design products made by unskilled or semiskilled workers tending expensive, single-purpose machines. These churn out standardized products in very high volume. Because the machinery costs so much and is so intolerant of disruption, the mass-producer keeps standard designs in production for as long as possible. The result: The customer gets lower costs but at the expense of variety and by means of work methods that most employees find boring and dispiriting. [11] The Toyota motor corporation, by contrast, combines the advantages of craft and mass production, while avoiding the high cost of the former and the rigidity of the latter. Toward this end, they employ teams of multi-skilled workers at all levels of the organization and use highly flexible and increasingly automated machines to produce volumes of products in enormous variety.

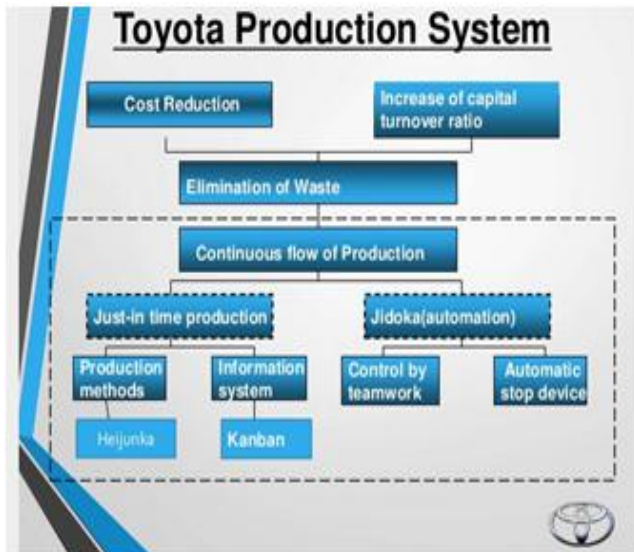


Figure 4. Background Knowledge of Toyota[11].

The Toyota Production System is also defined as Lean Production because it uses less of everything compared with mass production half the human effort in the factory, half the manufacturing space, half the investment in tools, half the engineering hours to develop a new product in half the time. Also it requires keeping far less than half the needed inventory on site, results in many fewer defects, and produces a greater and ever growing variety of products. Mass-producers set a limited goal for themselves good enough. Production methods, which translate into an acceptable number of defects, a maximum acceptable level of inventories, a narrow range of standardized products. Lean producers on the other hand, set their sights explicitly on perfection. [18]

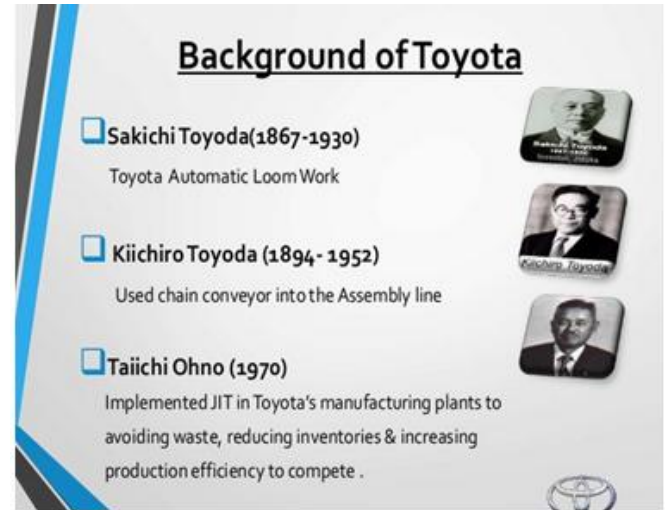


Figure5. Background of Toyota [11].

### B. Basic Idea and Framework

The Toyota production system is a technology of comprehensive production management the Japanese invented a hundred years after opening up to the modern world. The basic idea of this system is to maintain a continuous flow of products in factories in order to flexibly adapt to demand changes. The realization of such production flow is called Just-in-time production, which means producing only necessary units in a necessary quantity at a necessary time. As a result, the excess inventories and the excess work force will be naturally diminished, thereby achieving the purposes of increased productivity and cost reduction. [5] The basic principle of Just-in-time production is rational that is, the Toyota production system has been developed by steadily pursuing the orthodox way of production management. With the realization of this concept, unnecessary intermediate and finished product inventories would be eliminated. However, although cost reduction is the system's most important goal, it must achieve three other sub-goals in order to achieve its primary objective. They include

- Quantity control, which enables the system to adapt to daily and monthly fluctuations in demand in terms of quantities and variety;
- Quality assurance, which assures that each process, will supply only good units to the subsequent processes.

Respect-for-humanity, which must be cultivated while the system utilizes the human resource to attain its cost objectives. It should be emphasized here that these three goals cannot exist independently or be achieved independently without influencing each other or the primary goal of cost reduction. All goals are output of the same system; with productivity as the ultimate purpose and guiding concept, the Toyota production system strives to realize each of the goals for which it has been designed. Before discussing the contents of the Toyota production system in detail, an overview of this system is in order. The outputs or result side as well as the inputs or constituent side of the production system are depicted.[17] A continuous

flow of production, or adapting to demand changes in quantities and variety, is created by achieving two key concepts: Just-in-time and Automation. These two concepts are the pillars of the Toyota production system. AWDJust-in-time basically means to produce the necessary units in the necessary quantities at the necessary time. Automation (“Jidoka” in Japanese) may be loosely interpreted as autonomous defects control. It supports Just-in-time by never allowing defective units from the preceding process to flow into and disrupt a subsequent process. Two concepts also key to the Toyota production system include Flexible work force (“Shojinka” in Japanese) which means varying the number of workers to demand changes, and Creative thinking or inventive ideas (“soikufu”), or capitalizing on workers suggestions.[20]

To realize these four concepts, Toyota has established the following systems and methods:

- Kanban system to maintain Just-in-time production
- Production smoothing method to adapt to demand changes
- Shortening of set-up time for reducing the production lead time
- Standardization of operations to attain line balancing
- Machine layout and the multi-function worker for flexible work force
- Improvement activities by small groups and the suggestion system to reduce the work force and increase the worker’s morale.
- Visual control system to achieve the Automation concept
- Functional Management system to promote company-wide quality control. [11]

## VII. CONCLUSION

The key competitive factor has become speed. All else being equal, the faster a business responds to its customers, the more profitable it is. In high velocity manufacturing, everything is moving. Machines, people, funds and materials are constantly moving. Therefore, inventories in storage or on the shop floor are moving inventories rather than sitting inventories. Inventories are stocked only for a very short time, and will move to other locations only moments after being stocked. The conditions of high velocity manufacturing include flow manufacturing, line balancing, level schedule, and linearity. Toyota Production System and more importantly its core elements “Kanban” and “Jidoka” systems. Toyota Production System has not encountered many such incidents which directly pose a threat to the existence of Just-in-Time System in Toyota and other manufacturing firms in Japan. Most of the time, Toyota has suffered a lot due to these shortages from its supplier. But no one is to be blamed for it because most of the shortage occurrences were due to natural disasters or unforeseen events. Japan is located on one of the most active seismic plates of earth crust. So it will naturally make it prone to such disaster events across Japan. This has also given a spark by respected scholars in Japan and across the globe, why

Toyota is not making any efforts to combat such situations for future and secondly, it should move towards other production systems.

## VIII. REFERENCES

- [1] Adler, Paul S. and Robert E. Cole, ‘Designed for Learning: A Tale of Two Auto Plants.’Sloan Management Review, Vol. 34, No. 3 (Fall), pp. 85-94, 1993a.
- [2] Adler, Paul S., Barbara Goldoftas, and David I. Levine, ‘Ergonomics, employeeinvolvement, and the Toyota production system: A case study of NUMMI’s 1993 model introduction’, Industrial & Labor Relations Review, 50(3): 416-437, Apr. 1997.
- [3] Barnard, Chester, The Functions of the Executive, 1938.
- Barley, Stephen R., “Images of Imaging: Notes on Doing Longitudinal Field Work”, Organization Science, Vol. 1 No. 3, August 1990.
- [4] Bocard, Ronald R., Push vs. Pull: Is One Better than the Other?, Production & Inventory Management Review & APICS News. 10(2): 39-40, Feb.1990.
- [5] Cusumano, Michael, The Japanese Automobile Industry: Technology and Management atNissan and Toyota, Harvard University Press, 1989.
- [6]Deleersnyder, Jean-Luc, Thom J. Hodgson, Henri Muller, and Peter J. O’Grady, ‘Kanban Controlled Pull Systems: An Analytic, Approach’, Management Science. 35(9): 1079-1091. Sept. 1989.
- [7] Hayes, Robert, and Gary Pisano, “Beyond World-Class: The New Manufacturing Strategy”, Harvard Business Review, January-February 1994.
- [8] Hirano, Hiroyuki, JIT Factory Revolution, Productivity Press, 1988. Hopp, Wallace and Mark L. Spearman, Factory Physics: 2nd Ed., McGraw-Hill, 2000.
- [9] Jaikumar, Ramachandran and Roger E. Bohn, ‘A dynamic approach to operations management: An alternative to static optimization’, International Journal of Production Economics, 27 (1992) 265-282.
- [10] Krafcik, John F., ‘Triumph of the Lean Production System’, Sloan Management Review, Fall 1988, page 41-52.
- Lawrence, Paul and Jay Lorsch, Organizations and Environment, 1967.
- [11] Monden, Yasuhiro, Toyota Production System : An Integrated Approach To Just-In-Time 2<sup>nd</sup> Ed. Norcross, Ga. : Industrial Engineering and Management Press.
- [12] Sarker, Bhaba R., “Simulating a Just-in-Time Production System”, Computers & Industrial Engineering, 16(1): 127-137. 1989.
- [13] Spear, Steven J. “Essence of Just-in-Time: Imbedding diagnostic tests in work-systems to achieve operational excellence, The,” Production, Planning, and Control, (forthcoming) and HBS Working Paper 02-020.
- [14] Fujimoto, T. (2011). Supply Chain Competitiveness and Robustness: A Lesson from the 2011 Tohoku Earthquake and Supply Chain “Virtual Dualization”. Manufacturing Management Research Center.
- [15] Just In Time. (2016, September 29). Retrieved November 25, 2016, from Toyota Global: [http://www.toyotaglobal.com/company/vision\\_philosophy/toyota\\_production\\_system/just-in-time.html](http://www.toyotaglobal.com/company/vision_philosophy/toyota_production_system/just-in-time.html)

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- [16] Kubota, Y. (2016, April 19). Japan Earthquakes Rattle Toyota's Vulnerable Supply Chain. Retrieved September 10, 2016, from The Wall Street Journal: <http://www.wsj.com/articles/japan-earthquakes-rattle-toyotas-supply-chain-1460986805> 57
- [17] Lu, D. J. (1989). Kanban/Just-In-Time At Toyota: Management Begins at the Workplace. Productivity Press.
- Marksberry, P. (2013). The Modern theory of the Toyota production System: A Systems Enquiry of the World's Most Emulated and Profitable Management System. Taylor and Francis Group.
- [18] McInnis, K. R., & Gross, J. M. (2003). Kanban Made Simple: Demystifying and Applying Toyota's Legendary manufacturing Process. American Management Association.
- Monden, Y. (2012). Toyota Production System: An Integrated Approach to Just-In-Time. Taylor and Francis Group.
- [19] Nishiguchi, T., & Beaudet, A. (1998, October 15). The Toyota Group and the Aisin Fire. Retrieved September 25, 2016, from MIT Sloan Management Review: <http://sloanreview.mit.edu/article/the-toyota-group-and-the-aisin-fire/>
- Nishiguchi, T., & Beaudet, A. (1998). The Toyota Group and the Aisin Fire. Sloan Management Review.
- [20] Tajitsu, N., & Yamazaki, M. (2016, April 17). Toyota and Other Major Japanese Firms Hit by Quake Damage, Supply Disruptions. Retrieved September 8, 2016, from Reuters: <http://www.reuters.com/article/us-japan-quake-toyota-idUSKCN0XE080>.