

Toyota Production System: “Epistemology of Paradigm shift in Japan”

MUDASSER ALI KHAN

**Institute of Business Management,
Karachi, Pakistan**

DR. IRFAN MUHAMMAD

**Institute of Business Management,
Karachi, Pakistan**



Abstract

Toyota Production System (TPS) gained a remarkable success and results in industrial leadership by displacing the powerful automobile manufacturing companies. TPS model that was imitated by its rivals, as well as by companies from various other sectors. Due to the adaption of TPS, Japan was able to become a pioneer in creating and leading new automobile manufacturing paradigm. The objective of this article is to study the management techniques of Toyota Production System. The methodology of this work adopts a bibliographic research approach. It is an analysis of the literature on the evolution of TPS demonstrating some of its core management techniques. The result is the contribution to understanding the construction of culture Toyota's organizational structure, in order to direct a path to be followed by other companies that wish to replicate the management model. It is evident that the manufacturing philosophies practiced by Toyota were supposed to be a paradigm shift for the company itself as well as for Japanese nation.

Keywords : Toyota Production, TPS, Japan, Industry

1. INTRODUCTION

The evolution of social needs drove industrial development and the creation of increasingly organized production processes. At the beginning of the 20th century the focus of the productive systems was mass production, a fact favored by the application of the Scientific Management ideas launched by Frederick Taylor, implemented by Henry Ford in car manufacturing. The second half of the 20th century, specifically in the 70s, was marked by the post-war contributions from Japan where Toyota Motor Company develops the Toyota Production System being hailed as the source of Toyota's spectacular performance as a manufacturer.

Due to the success and results obtained by the Toyota Motors Company, surpassed other automobile manufacturers in number of vehicles produced, market value and profit. Studies are carried out in order to understand the secret of the success of the company that is now copied by its competitors, as well as by other companies from different sectors.

It turns out that the growing difference between Toyota and the other companies has meant that many questions arise. Among these questions, the most intriguing is about the success of Toyota. Therefore, the challenge for companies, since then, is to copy the model in an attempt to achieve the same results and turn production operations to an advantage competitive in order to survive the fierce global dispute, by reducing costs and, at the same time, the production of small quantities of many types of products.

Porter (1999) confirms that this initiative by companies to improve quality with costs minors is forced by customer demands and global competitiveness, because to compete effectively in this highly competitive environment, companies must continually innovate and seek continuous improvement of competitive advantages. In this context, Toyota emerges as global leadership in obtaining better results at the lowest cost, because, really transformed the operation towards a competitive advantage grounded on tools and continuous improvement.

The objective of this study is to enlighten the epistemology of Toyota Production System and further find out philosophical relationship with the paradigm shift occurred in Japan due to adoption of subject production system. The study will also urge about management techniques used by Toyota in achieving great success and management philosophy of TPS for the construction of organizational culture.

2. METHODOLOGY

This article analyzes the bibliographic research carried out on literature that approach the Toyota management model, mainly through Jeff Liker's book that describes the principles of the management model.

In this context, the literature reviews are presented as an important activity for identify and know a certain area of knowledge. Further. In addition, reviews allow for the identification perspectives for future research, contributing with suggestions for ideas for the development of new research projects. (Noronho & Ferreira, 2000)

First, we study the origin of TPS and the way its creators question the old paradigm created by Ford. Soon after, an analysis is made of how this model migrated to Western companies, making it one of the most copied systems today. It also seeks to extract from the literature the management techniques that transformed the model into a work philosophy, in which Toyota makes use of it to turn operations into an advantage competitive. In this context, it is understood how their interaction with people and other interested parties, such as the customer.

3. PHILOSOPHICAL PERSPECTIVE

The objective of this study is to enlighten the epistemology of Toyota Production System and further find out philosophical relationship with the paradigm shift occurred in Japan due to adoption of subject production system.

Saunders et al., (2012) suggest that there are two major ways of thinking about research philosophy: ontology and epistemology. Each highlight and describes important influences or understanding of the ways in which the research process can be conducted. Ontology is concerned with the nature of reality and provide a perspective about the way the world operates and can be described from two perspectives i.e. objectivism and subjectivism. On the other hand, Epistemology concerns with the researcher's view regarding what constitutes acceptable knowledge. These are identified epistemological approached that are positivism and interpretivism. Positivism advocates for the stance of the natural scientist whereas Interpretivist find acceptable knowledge to be subjective meanings and social phenomena.

This study adopted an epistemological perspective of Interpretivism and adopt the method of the interpretivist paradigm, which emphasizes that "understanding of the production system being adopted in Toyota " is not only the understanding of the text the

system, but also the universality of the system. As for interpretivist paradigm pay more attention on describing and analyzing the research topic, interpretivist approach seems appropriate to this study.

Toyota is using two well-known approaches in their production system and both are based on epistemological interpretations. The push-based system is based on a proper plan whereas pull based system is based on state of the production systems. The pull base system is related to the world of ideas and the push system is based on the material world. Likewise, there is a difference between Toyota Production System and Toyota's Production System. Toyota Production System is static. It can be treated as explicit knowledge where every single tenet, every single tool and every single concept is written down. However, what Toyota does on a day-to-day basis is personal to the Toyota plant. This cannot be written down. Toyota's Production System is dynamic where the solutions are unique to the problems that the specific Toyota plant experiences. Another concept that Toyota emphasizes is gaining consensus on the basis of interpretation of various solutions.

To understand the philosophical approach to be used in this study, there is an ontological assumption that in reality the Toyota production systems is transferable to other automotive manufacturing industry or not. Given the fact that complete transferability is difficult to the greater extent, however, this is relativistic approach since to establish the truth it is necessary that consensus between different point of views must be established. Therefore, epistemological interpretive approach has been adopted in this study.

4. THE EVOLUTION OF TOYOTA PRODUCTION SYSTEM (TPS)

TPS emerged from a study by Eiji Toyoda together with his main production engineer Taiichi Ohno over another existing model applied at the Ford plant, hitherto the most efficient and complex unit in the world. The mass production model, created Henry Ford, opposed the old production model that built hundreds of cars for year, all manufactured by the classic handcrafted system. During that period, the production volume was very low when compared to the present day. About a thousand cars were produced a year and, hardly two identical cars would be found (Womack, Jones & Roos, 1992).

While visiting to the Ford Motors to analyze the process of mass production, Toyoda & Ohno understood that the market having uneven demand numbers will not require higher production volumes. So, in order to endure, we should realize adaptation is required, that is, in contrary to the Ford philosophy, it is necessary to produce little volumes but having variants by using the same manufacturing line because the requirement for the market in

Japan market demands lower cost, superior quality, flexibility with lesser lead time(Ohno, 1997).

Furthermore, on the field trips to American factories in 1950, they also observed a lot of machines were involved to produce larger volumes and forming stocks that were transferred to further processing, resulting in creating work in process inventory for a longer period of time (Ohno, 1997).

During the visit to Ford Motors, the author also understood the importance and advantage of continuous production line i.e. reduction in waste as the units are manufactured in view of the established need of the customer. However, by implementing Just in time and Kanban system to the subject assembly line, manufacturing flow will be increased and time will drastically be reduced. On the other hand, by practicing PDCA Cycle (Plan, Do, Check, Act) the target of continuous improvement can be achieved.

Ohno (1997) states that analyzing US companies is the initial step to understand competitor's manufacturing strategies while understanding the possible impact on the culture and then providing improvements in these strategies will be required in order to make the necessary adaptations to reality. The legacy of Toyota family is to teach and reinforce the value system that founders left i.e. finding the basic cause of the issue, fact findings and innovation etc.

According to Womack et al (1992), the term Lean Manufacturing is currently used which was coined in the book *'The Machine that Changed the World'* that deals extensive study on TPS. The authors popularized this term in the West through results of a survey conducted by the Massachusetts Institute of Technology - MIT on a comprehensive description of the entire Toyota business system, product development, supply management, consumer relations, order fulfillment from raw materials to production and management of the entire company. From the publication of the study at MIT, Lean has been the management model chosen by companies trying to implement in its factories the same differentiated practices as TPS, in order to achieve the same levels of Toyota's performance.

Womack and Jones (2004) defines "Lean" as an approach that pursues an optimistic way of managing relationship of the company with its production along with the suppliers and customers. According to his technique, synergies are being developed i.e. to get more outputs with lesser inputs.

According to Shah and Ward (2002), the Lean approach comprises of variety of practices which includes Just in time scheduling, quality management among others. Shingo (1996) confirms the power of TPS through an analogy, which states that the management model is so powerful it could extract water by wringing a dry towel.

5. A STRATEGIC WEAPON FOR COMPETITIVENESS

As studied by Liker (2005), Toyota's success maintained the perception of high quality as seen by consumers, so that people can be confident that products of Toyota will work for the first time and will continue to function well. This reputation can only be translated into exchanges with policies based on the philosophies of continuous improvement i.e. JIT, Continuous Flow, Autonomous, Kaizen, etc. This approach has helped in implementation and revolution in lean manufacturing system.

The author also states that due the great influence of the lean manufacturing system, many of competitors have implemented TPS principles partially, that is, few of the companies have only considered 5s Tools (senses of use, organization, cleanliness, standardization and self-discipline) and just-in-time, without fully understanding the TPS that should be inserted in the culture organizational. On the other hand, few companies failed to involve their higher management in day-to-day operations and in the projects of continuous improvement, which must be considered as the most fundamental thing to success of the subject philosophy.

The author also states that adopting a system of lean management requires all together diversified way of thinking i.e. considering to make a flow of production system through ongoing processing that create value for internal and external stakeholders. A “Pull” system will be used instead of “Push” system from where the demand of the customers are derived, which in turn, pulls only what it needs and when it needs it.

According to Liker (2005), Toyota studied and found that the key to this practice is flexibility, i.e. if you work with shorter timelines with flexible line of production, you get higher quality, more customer feedback, a higher standard of living and more efficiency. That would be it. This means that space is put in place for better use. In the 1940s-1950s, Toyota focused on eliminating the loss of time and materials at all stages of the production process, from the import of raw materials to the final product.

Toyota Production System model is based on 4Ps i.e. Philosophy, People, Process & Partners however, in actual the companies mostly focusing on the “P of the process only and

they forgot to develop other “Ps” which are very crucial for the successful implementation of TPS.

The author urges that many critics describe Toyota as a boring company but the results of quality, profitability, reputation as the best manufacturer in the end up making criticisms irrelevant. The fact is that TPS has brought Toyota improvements incredible results for the effectiveness and stability of the business through management techniques Toyota, in which it provided the development of a culture aimed at continuous improvement through the total involvement of people.

6. MANAGEMENT TECHNIQUES

6.1 Waste

According to Ohno (1997), TPS is based on the principles of a culture of continuous improvement and cost reduction. The author establishes as a preliminary step for the application of the TPS the identification and elimination of waste that requires time on the factory floor to learn to map the process activities that add value and those that do not add value to the product.

Liker (2005) corroborates with Ohno stating that the first step is to examine the process from the perspective of the internal and external customer. It identifies eight types of waste that do not add value to the business, they are: excess production, waiting time (operator or machine), unnecessary transportation, excessive or incorrect processes, excessive stock (raw material, semi-finished and / or finished), unnecessary human movement, defects and its consequences, underutilization of labor. Toyota considers excess production to origin for other waste.

The author points out that waste is currently the most damaging survival of companies in the face of competitiveness, whether in industry, in civil construction, in agriculture and also in government. Waste is anything that consumes some kind of resource, however it does not add any value to the process, so to make a profit, continue to survive and employing, the absence of waste in companies is the goal to be achieved at all costs.

According to Liker (2005), waste is hidden everywhere in production. To avoid this, one must fully understand what waste is and its causes. All waste is become part of the direct and indirect costs; therefore, they are relevant points in the search for the reduction of costs.

When thinking about the total elimination of waste, keep in mind that increasing the efficiency only makes sense when it is associated with cost reduction. To achieve this, it is necessary to start producing only what is needed using a minimum of labor. Note the efficiency of each operator and each line. Then look at the operators as a group, and then efficiency across all lines. Efficiency must be improved at each stage and at the same time for the factory as a whole. The real improvement in efficiency comes when producing zero waste and the percentage of work is increased to one hundred percent.

According to Liker (2005), an adequate process will produce the correct result. A good the beginning for a company to eliminate waste is to create a continuous flow in the manufacture. Streaming tends to force the implementation of several other TPS tools, that is, by lowering the stock level, we will make the problems visible, so action to resolve them and not just hide them.

The author points out that creating a continuous flow means joining operations that were previously separate, so whenever the manufacturing operations are aggregated together, there will teamwork, the feedbacks will be more of quality problems, the process will be controlled and the people responsible for solving problems are triggered immediately.

As far as possible, the manufacturing flows between processes of continuously, optimizing and taking advantage of the available spaces, in order to minimize movement of people, products, materials and documents. It is necessary to establish a flow rational work. When processes are improved and levels of training and employee motivation, waste rates fall naturally. You should never consider that a sufficient level of quality has already been reached to allow accommodation. It is necessary to seek improvement continuously (Liker, 2005).

6.2 Leadership profile

As stated by Liker (2005), the difference between Toyota's top executives and those of other organizations, is that the leaders of competitors CEO due to progress and internal promotions, on the contrary, they abruptly came from outside to change the organizational culture, move and change the direction of companies that were going bad.

The truth of the matter is that numerous associations shift back and forth between outrageous achievement and the insolvency outskirts. The arrangement found for these cases is to get new CEOs who will lead the organization to alter radical course.

In spite of this mentality of searching for ability outside the organization, Toyota builds up its CEOs inside, that is, there is progress and advancement of leaders through planning constantly joined by a mentor who advances all the instructions of fundamental TPS techniques about Toyota standards. Since Toyota's commencement, leaders were from inside the organization, at the right time to proceed with the subject transformation, they were at that point there in the business, improvement, producing, plan division, and so on. However, notwithstanding close to home contrasts in the board style, none of these pioneers wandered from the essential way of thinking of TPS, so Toyota consistently has a pioneer arranged to hold an official position who truly comprehend the work, practice reasoning and show others (Liker, 2005).

As indicated by Liker (2005), the genuine leader inspires and builds up his team via preparing them to follow up on their own, allotting them tasks critical to the organization's prosperity, permitting them to practice with opportunity and self-rule without dreading inner rivalry. The leader comprehends that your prosperity relies upon the accomplishment of your workers. The genuine leader practices initiative by model. There is no single style or of leadership applicable to all circumstance. Each kind of circumstance requires an alternate sort of administration to accomplish adequacy of workers.

Long-term success lies in the ability to do important things in a better than competitors. And for that, people can help a lot, more than companies they could imagine and much more than people could even think. People they form the fundamental basis of all the quality and productivity of the company. They make the difference. For this, participatory management is needed, which shares and which stimulates creativity and innovation.

6.3 Team work

As stated by Liker (2005), most of the organizations have experienced that working group's use fire-fighting approach to aid the manufacturing units, inspection of products and rectification. However, in case of smooth manufacturing, these groups

went into idle mode and take breaks from their work. Obviously, these organizations have not adapted Toyota Production System inserted in their cultures.

The author also emphasized that organizations first create a strong support culture within them and then set up teams that can work and add value to the organization. Creating Toyota-like culture will definitely require time; however, a suitable motivational program must also be present. Employees need to have felt of belonging to a team. The culture must also be open for employee feedbacks as well as recognition of employee's ideas.

Liker (2005) states that the employee feel satisfaction from a job well done, enabling them to contribute to an improvement process, through the identification of causes and the creation of necessary mechanisms so that failures and errors do not reoccur. In this way, we have a double beneficial effect that in addition to contributing to the solving the problems of the company or organization, employees also start to feel more satisfied, which makes them more productive and more interested in contributing, in a circle virtuous in which everyone wins, and which accelerates continuously. The great advantage of working in groups is that the synergies are developed and the weakest team member is supported by the strongest one.

According to Liker (2005), the manufacturing process must be perceived with an open mind. Repeat the question "Why?" five times for each problem encountered. The only way of verifying the effectiveness of the TPS on the production floor is to see on the spot and question. The leader need to personally observe the flow of material on the line and address the issues.

6.4 The Pulled Production

According to Liker (2005), the philosophy of TPS is not to manage stocks, but to eliminate them. From the beginning, Toyota thought about pulling the necessary based on the customer's need, contrary to the old system that pushes. Pull means the supreme state of manufacturing through just in time approach, i.e. providing the customer what he really wants.

The author also points out that in order to minimize equipment changes, set-ups, which are necessary to make various types of SKUs with the very same equipment, one must maintain a buffer (small stocks). Visible signs were developed to control and maintain the level of these small batches such as: cards, empty boxes, empty carts, etc. These visual cues they are called Kanban (card).

6.5 Visual control and standardized work

According to Liker (2005), the most important task when we are going to implement the standardization is to find the compromise between the employees and strict policies that needs to be followed and at the same time to give them the freedom to innovate things and ready to contribute to the goals of cost, quality and delivery.

The author stresses that the first standards and instructions must be in line with the guides, yet usual enough to allow innovation and flexibility and easy understanding for anyone who will use it. It is important to use the ideas of the employees to improve work instructions, giving them the opportunity to contribute to continuous improvement in the process. People want to be able to take responsibility for their own resources. Want feel they are making a personal contribution to something important. That's how you get true motivation and true participatory management. Variations, errors or deviations must be corrected so that operations are normalized. Standardization aims to maintain the performance within the pre-established level and also ensure that everything is done exactly according to what was intended to be done (Liker, 2005).

For Liker (2005), the visual controls also include the deviations between the goal and the realized displayed in graphic form, where they are fixed in a public place and easy to view. THE major issue to be observed is the possibility of walking around the company and recognizing that the work, procedures and goals are being followed and achieved.

The author points out that in the production lines, the use of visual controls, or management by sight, it becomes mandatory. Therefore, it is necessary to establish a standardized process by current conditions quickly become visible in the workplace allowing everyone employees to immediately view the normal or abnormal situation, as well as recognize the situation and take action to return to the standard condition.

7. TOYOTA PRODUCTION SYSTEM TOOLS

7.1 Automation

According to Ohno (1997), Toyota Production System (TPS) uses an autonomous machine which was created by Toyoda Sakichi, autonomy involves the transfer of human intelligence into a machine. The subject machine works with a device that allows for specific judgment. The Toyota concept promotes the idea of a machine and a production line to employees, so in rare cases an employee

immediately stops the line. The subject tool can prevent the production of defective products, eliminate the decrease in production, and in the case of irregularities, the immediate discontinuation of the production line should be demonstrated until after the research by Ohno (1997).

7.2 Just-in-time

According to Monden (1993), the term “Just in Time” is used to refer to a process that shows the capability to immediately respond to the demand without stocking for buffer inventories. Therefore, the main objective of Just in Time is to maintain zero stocks thus eliminating investments in raw material across supply chains.

The philosophy behind Just in Time (JIT) operations is to create subsets and components in small groups and to transmit them in time to the next stage of the process. JIT is an enterprise-wide philosophy focused on eliminating all operations, continually improving every aspect, eliminating unnecessary inventory and reducing costs, high quality, flexibility and customer service (Batman & Snell 1998)

7.3 Kanban

According to Hoppmann (2009), the word “Kanban” is defined as a signaling system used to allow materials movement for production. It is basically a control system used to maintain production flows on assembly line. The major benefits of the system are to reduce idle time for inventory and to improve productivity in continuous flow of materials

Kanban is a Japanese proprietary forwarding control system (bus time). The Kanban is a method of demanding the entire product and therefore runs counter to traditional processing processes. It is a simple system to control a new factory, with exactly the same controls and central control. (Holman, 2009, p. 29)

7.4 Flexible Production

Batman and Snell (1998) argue that flexible manufacturing offers a wide range of products and production choices, unlike traditional factories, which have a limited production capacity organized in a workgroup in a such a manner that facilitates proximity between employee locations, move parts, reduce or eliminate production time.

7.5 Kaizen (Continuous Improvement)

According to Laraia, Moody's and Hall (2009), continuous improvement can be interpreted as "sustainable development" and demanding quality or global

production increases and short-term mechanical and manual labor defined as regional productivity. Or waste your production process. The author understands the groups that bring people together work with knowledge of trained professionals, as well as the type of disciplinary action required, and require the ability to work on equipment to ensure that changes are made to actual support. Teamwork involves using simple replacement tools based on a mutually agreed framework.

According to these authors, the ongoing Kaizen system is highly interactive, which means that it becomes difficult, not just to offer suggestions, to lead the team to design and implement solutions to make new processes or change the currently available. The results for the improvement process may be different from one organization to another depending on the below mentioned principles:

- Open and clear mind;
- Positive mental attitude;
- Generate solutions and discard excuses;
- Suggest ideas instantaneously;
- Perform with available resources;
- Utilize knowledge of the entire team;
- Neglect the pyramid of hierarchy and making all team members are equal
- Take action.

8. RESULTS

It is evident from the study that Toyota has achieved remarkable success by implementation of Toyota Production System not only within their organisation as well with their vendors and customers. The study demonstrates that the companies who wants to achieve success must adapt Toyota-like culture along with the manufacturing techniques. They need to leave behind their old habits and must understand that the company's culture is a set of beliefs of their people therefore, it is an important resource. Cultural values must be inserted as an aspect of their manufacturing strategy to properly develop their personnel and vendors. It is also important to understand that the companies need to do global changes in their cultures and consider it as their investment.

References

- Bateman, T. S., & Snell, S. A. (1996). *Management: Building Competitive Advantage*. 3 rd Edit. *Chicago: Irwin*.
- Hines, P; Taylor, D. (2000); *Lean Manufacturing Implementation Guide – Lean Manufacturing*. *São Paulo; Imam*.
- Hoppmann, J. (2009). *The Lean innovation roadmap – A systematic approach to introducing Lean in product development processes and establishing a learning organization –. Diploma Thesis, Technical University of Braunschweig & Massachusetts Institute of Technology, Braunschweig, Germany*.
- Laraia, Anthony C .; Moody, Patrícia E .; HALL, Robert W. *Kaizen blitz: Process to achieve continuous improvement in organizations*. *São Paulo: Leopardo, 2009*.
- Liker, J. K. (2004). *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer* *McGraw-Hill Education*.
- Monden, Y. (1993). *Toyota Production System: An integrated approach to Just-in-Time* (2nd ed.). *Norcross, GA: Industrial Engineering and Management Press*
- Noronha, D. P., & Ferreira, S. M. S. P. (2000). *Literature Reviews*.
- Ohno, T. (1997). *Toyota Production System: Beyond large-scale production*. *Productivity Press*.
- Porter, M. E. (1999). *On “Competition” Essential Competitive Strategies*.
- Schein, E. H. (1985). *Culture and leadership.*, *San Francisco: Jossey-Bass*.
- Shah, R., & Ward, P. T. (2003). *Lean manufacturing: context, practice bundles, and performance*. *Journal of operations management*, *21*(2), 129-149.
- Shingo, S. (1996). *A study of the Toyota production system from an industrial engineering viewpoint* (Rev. ed.). *Cambridge, Mass.: Productivity Press*.
- Womack, J. P., Jones, D. T., & Roos, D. (1992). *The machine that changed the world*. *New York: Harper-Collins*.
- Womack, J. P., & Jones, D. T. (2004). *Lean Thinking: Banish waste and create wealth in your corporation*. *New York: Simon & Schuster*.