

# The Evolution and Challenge of Lean Philosophy to Production Systems

Bañez, Jeremy Laurence M.

Industrial Engineering Department, Bulacan State University, City of Malolos, Bulacan,, Philippines

**Abstract:** *In search for company's improvement, Japan through Toyota gave birth to the lean philosophy to make the country competitive with other countries especially with the Westerners like America. In this regard, lean may be considered the new face of Toyota Production Systems (TPS). Lean approach has simple principles yet very powerful in terms of production system's effectiveness, efficiency and productivity. Being engaged to lean is like being engaged to a program that enables someone to be as much as possible "fatless". Fats being considered here are the muda or wastes that a company may generate. The concept of lean was derived from just-in-time concept and total quality management that the former was lack of. It was indeed in the midst of scarcity that Japan made this breakthrough in production systems from just-in-time to total quality management to lean. The emergence of Six Sigma may also enhance this lean philosophy and can serve also as another philosophy. All these things happen in line with continuous improvement initiative and making these philosophies like lean to be a way of living.*

**Keywords:** *Continuous improvement, Just-in-time, Lean, Muda, Toyota Production Systems*

## 1. INTRODUCTION

In line with manufacturing firm's aim for excellence to provide the needs of their customers, many production systems emerge. These systems evolve as time goes by to provide greater effectiveness, efficiency and productivity to the customers. This evolution is a firm's way of response to the ever-changing needs and wants of customers. This is to have a better leverage for the firms in gaining profits and reducing costs. Having such leverage makes the company more competitive and sustainable in the market.

One of the latest emerged production systems is the lean production system. The idea of lean approach is very simple which about eliminating if not so reducing different kinds of wastes in the production. These wastes are the so-called Japanese word, *muda*. Wastes are classified into 8 types and these are: defects, overproduction, waiting, non-utilized talent, transportation, inventory, motion and extra processing with an acronym of "DOWNTIME". Lean approach aims to cut down costs brought about by these wastes to maximize the value of the products and/or services offered by the firm.

To achieve the goal of lean approach, its guiding principles must be known first and then applied. These are the value, value stream, flow, pull and perfection. First, the customer value is specified to be able to determine their needs. After that, the value stream is mapped involving all the processes involved from the inputs to the outputs. Its goal is to identify the value and non-value adding activities in the map in order to weed out the non-value adding activities. After removing the non-value adding activities, there must be a smooth flow towards the customer without any interruptions, delays, or bottlenecks. Improving the flow can make the delivery of products will be much easier as needed by the customers. This concept is known to be "just-in-time" concept. It can make customers to "pull" the products as they need them by which it can reduce the level of inventory inside the company. Doing the first four (4) principles is not enough if the last principle will not be applied. It is for the reason that lean thinking and process improvement must be integrated to the company's culture. This is because lean is a dynamic system which needs constant effort for perfection. In addition, all employees of the company must be involved in this lean initiative. (Womack & Jones, 1997)

Looking at the different companies nowadays, many of them are now engaged with the lean approach. It is now widely known and accepted approach across different companies around the world. In the United States, some of the known lean manufacturing companies are Ford, Deere and Company, TRW, Eaton, PepsiCo, and Hon Industries. In France, lean approach is also embraced by some manufacturers there like Valeo, CarnaudMetalbox, Plastic Omnium, Renault, and Legrand. (Schonberger, 1996) In Asia, particularly in Japan, Toyota is the leading lean manufacturing company. As seen on the companies presented, lean is not only popular to a particular part of the world rather it spreads out across the world. Its remarkable contribution in terms of improvement is being experienced by different companies around the globe.

Because of the presented concepts and popularity of lean, it is agreeable to know the reason behind its evolution. Tracing its roots may give us a background of its development, pros and cons, and deeper understanding about this approach. It is for the reason that fruits of lean are present because of its roots. Aside from that, it is good to know the position of lean as it evolves and what transformation it has made, is

making, and will be making. Through this transformation, continuous improvement endeavor is now being exercised.

## 2. EVOLUTION OF LEAN PRODUCTION SYSTEM

With the rise of Industrial Revolution, production systems are developed spearheaded by the Westerners particularly by Americans. In times of Industrial Revolution, mass production and craftsmanship are the known factory systems. The trademark of these factory systems is efficiency, interchangeable parts and economies of scale. Since America has abundant space, energy, and material resources, its manufacturing way is to produce with large lots. This results to high volume of inventories particularly the work-in-process inventories. Standardized designs for component parts also add up to this kind of bulk volume of work-in-process inventories of parts. This standardization is a product of work study by making work method simpler and more efficient. In addition to the work study, a comprehensive computer-based manufacturing management system known as materials requirements planning (MRP) was developed in the United States. This MRP makes the United States to be most proficient in job-lot manufacturing management. (Schonberger, 1982)

On the other hand, in contrast with Americans, Japanese has the history of space and resource limitations which makes the country inclined with conservation. This gives way to the development of just-in-time (JIT) concept (later on to lean approach) in Japan. The company which initiate the said concept is the Toyota Motor Company through Taiichi Ohno. His objective is to catch up in the automobile industry with the Americans in three (3) years. He believed that if they cannot catch up, the automobile industry in Japan will not survive. For Ohno, productivity is the key parameter for Japan to be competitive with America. This can be done through waste elimination to reduce costs. Toyota could not reduce costs through economies of scale of mass production because the market for automobiles in Japan was small unlike American automobile companies. This leads to the managers of Toyota to use a manufacturing strategy of producing many models in small quantities. This strategy may impose challenge to maintain smooth production flow in this varied product mix. Moreover, to avoid waste, this must be done without large inventories. This system is addressed by two (2) pillars namely just-in-time (JIT) which is about producing only what is needed and automation which is about automation with human touch so that they can operate many machines and automatically detect problems. In addition, this JIT is a model similar to that of American-style supermarket. (Hopp & Spearman, 2008)

JIT as described by Robert Hall who is one of the first Americans to describe it, is linked with stockless production and zero inventories. But this does not

mean that firms should operate without inventory. There are seven (7) zeros which are required to achieve zero inventories namely:

- Zero defects
- Zero (excess) lot size
- Zero setups
- Zero breakdowns
- Zero handling
- Zero lead time
- Zero surging

It can be observed in American companies to take setup times (or costs) as fixed and tried to come up with optimal lot sizes. These setups were tried to be eliminated or at least reduced by Japanese to eliminate or to reduce lot-sizing problem. Also, Americans took infrequent, expensive deliveries from vendors as given and tried to compute optimal order sizes. Contrastingly, Japanese set up long-term agreements with a few vendors to make feasible deliveries. With regards to defects, Americans took them as given and set up huge inspection procedures to find them. On the other hand, Japanese ensure that both vendors outside the plant and operators inside the plant were aware of quality requirements and equipped them with necessary tools. In addition, American manufacturing engineers got product specifications from design engineers and they just adapted them. For the Japanese manufacturing and design engineers, working together is better to ensure designs that are practical to manufacture. (Hopp & Spearman, 2008)

To implement JIT, there are many factors to be considered which are consisted of the following:

- Production smoothing – heijunka
- Capacity buffers
- Setup reduction
- Cross-training and plant layout
- Less work in process

In the manufacturing system, customer demand generates requirements. The sequence of producing the products is not necessarily the same with the sequence of how the customers will purchase the products because demands are never completely known. For this reason, companies use master production schedule (MPS) to specify which products will be produced in each time interval. This MPS must be reasonably level over time and this was stimulated by Toyota system called heijunka. This shows a steady flow rate of producing discrete parts called repetitive manufacturing. Due to unanticipated disruptions in reality, Japanese make use of capacity buffers. This is done through scheduling the facility to less than the available time per day (24 hours per day) in order to catch up if the line falls behind. Regarding setups, these are traditionally regarded as given in America and large

lot sizes were used to keep the number of changeovers to a manageable level. This is contrast to Japan's system of reducing setup times by using small lot sizes and classifying internal setup (tasks that take place when the machine is stopped) with external setup (tasks that can be completed while the machine is running). To be able to reduce setup according to Monden, internal setup must be separated with external setup, internal setup must be converted as much as possible to external setup, adjustment process must be eliminated and the setup itself must be abolished. (Hopp& Spearman, 2008)

Aligned with the objective of having a smooth flow, multifunctional workers can be a big help. This can make workers to cope up with product mix changes and other exceptional circumstances for workers have multiple skills which add up to their flexibility. In Toyota, multi-skilled workers are cultivated through worker rotation system to keep multiple skills sharp, to reduce boredom and fatigue on the part of the workers, to foster an appreciation for the overall picture on the part of everyone, and to increase the potential for new idea generation since workers would be thinking about how to do their job. In addition, Japanese did cross-training among their workers to catch up with the American in terms of labor productivity. With cross-training and automation, it can make workers operate several machines at once. In addition to this, a better layout to make workstations close to each other to provide smoother flow. Japanese make use of "U" shaped lines or cells which is different from American's linear arrangement of machines which is inefficient. (Hopp& Spearman, 2008)

In JIT system, less work-in-process (WIP) means better customer responsiveness for it cuts down cycle times. But like the uniform production sequences that created a demand for shorter changeovers, low WIP levels demand higher quality for JIT system simply cannot function with significant rework or scrap. This led to a new revolution which is the total quality management (TQM). Although the basic techniques of quality control were developed by Americans, it was within Japanese JIT systems that quality was lifted to new and strategic importance. In JIT, quality problems are not only highlighted but also facilitate identification of their source. Aside from that, the quality principles from JIT are:

- Process control
- Easy-to-see quality
- Insistence on compliance
- Line stop
- Correcting one's own errors
- The 100 percent check
- Continual improvement

Since Japanese emerging quality revolution was spreading, British government captured its benefits.

The basic idea is similar to Ohno's automation which includes determining the best practice, documenting it, an ensuring it is followed. Certificate is given to the companies that portray high-quality processes. This certificate is not included in Toyota's system. Consequently, it was criticized as ineffective in improving quality and burdensome in its documentation requirements. But despite of these complaints, International Organization for Standardization (ISO) is convinced for this idea which is now known as ISO 9000. This idea looks good but unfortunately, there is nothing requiring that the procedures used are good ones or even that following them results in high quality. (Hopp& Spearman, 2008)

After a study conducted in an automobile industry, it can be observed that JIT was replaced by lean "philosophy". Lean manufacturing provides neater package than did the various collections of JIT techniques. It is in this time that flow, value stream, eliminating *muda* wastes, and performing kaizen became popular among Japanese companies. Soon, many companies are desiring to be "lean" for the reason that it does not require a computer or software like MRP. It can be seen that many companies who applied the lean had cut down their inventories and lead times, and fattened their bottom line without the use of computer. With this regard, just-in-time philosophy was seemed lost which led to confusion of its benefits. But the thing is, JIT never really went away. It was only repackaged which is now known as lean. Same scenario was happened to TQM which was never disappeared either but rather enhanced into what we called Six Sigma nowadays. (Hopp& Spearman, 2008)

### 3. REFLECTION

Indeed, lean philosophy evolved from the concept of just-in-time in Toyota through Taiichi Ohno. With this regard, lean is rooted from Toyota production systems (TPS). Toyota is an automobile company in Japan wherein before they are struggling for competitiveness with the Western automobile manufacturers particularly the American automobile manufacturers. Knowing that Japan had a scarcity of resources which is opposite with that of America, it is really commendable not to be discouraged at these times. Thinking of possible ways to improve in times of trials will help a certain firm to position itself into the market as seen on what Japan did. With that kind of perseverance and dedication, Japanese make a kind of great contribution in production systems. Focusing on what is your goal is very important. That attitude led Japan to succeed in uplifting their status in the market and this is with the help of lean.

But lean does not mushroomed right away. It started with just-in-time and total quality management. Since Japanese have a concept of kaizen or continuous improvement, they never stop improving. They show that the improvement they made are not for short

period of time only for their concepts are just evolving. Just-in-time (JIT) is not really banished though leveled up into lean philosophy. Same thing happened with total quality management which is now coincided with Six Sigma.

Lean philosophy is really a great influencer in today's production systems as it emerged. It is for the reason that no computer or software is required in applying it. Its principles are very straightforward that there must first value that comes from the customers. Then, the value stream must be mapped to identify value-adding activities with non-value adding activities with regards to the value specified by the customer. After that, there must be a smooth flow so as the delivery to customers has no interruptions. This leads to the next principle which is about the pull system (or the so-called just-in-time system) wherein the customers can now ask for products and be delivered to them as they need them. The last principle which is the most important is the perfection or the continuous improvement of the lean initiatives. To add up, lean approach through just-in-time system is better matched with Six Sigma through total quality management for lean though reducing costs will not guarantee much of product quality.

With that sense, the emergence of new philosophies like lean and Six Sigma must be combined to provide a better system not only in production but for the whole organization as well. This can be achieved through proper management systems in the organization. Though the culture of Japan is difficult to pass on, its management systems are not. (Schonberger, 1982) This will lead to a better system as an imperative to continually improve. That is why, the challenge now is to make continuous improvement a way of life especially among firms.

#### 4. CONCLUSION

Lean is really a breakthrough to production systems as developed in Japan. It was developed out of the reason of Japan to improve their current state in production. Since Japan has limited resources, this brought challenge to Japan to compete with the Westerners like America in terms of manufacturing industries particularly the automobile industry. Due to their determination in pursuing to achieve their objective, Japan did obtain the success they wanted. From just-in-time concept to total quality management to lean and Six Sigma, all of these are the result of continuous improvement initiative of Japan. They want it straightforward concerning value creation to customers, cost reduction, profit generation and simplicity in techniques. All of these attributes can be seen in lean philosophy. The challenge to lean approach is how it will be sustainable such that it complements the culture of the company to make it a way of living. In addition, lean can be applied to any organization but it depends on how lean will be welcomed into it. As part

of lean principles, continuous improvement plays a role on this kind of endeavor.

#### REFERENCES

- [1] Hopp and Spearman (2008). *Factory Physics: Foundation of Manufacturing Management*. Irwin Publishing
- [2] Schonberger (1982). *Japanese Manufacturing Techniques: Nine Hidden Lessons of Simplicity*, 1<sup>st</sup> Edition. The Free Press, New York, 1982
- [3] Schonberger (1986). *World Class Manufacturing: The Lessons of Simplicity Applied*. The Free Press, New York, 1986
- [4] Schonberger (1996). *World Class Manufacturing: The Next Decade Building Power, Strength and Value*. The Free Press, New York, 1996
- [5] Womack and Jones (1996). *Lean Thinking: Banish Waste and Create Wealth in Your Corporation*
- [6] Womack, Jones and Roos (1990, 2007). *The Machine that Changed the World: The Story of Lean Production: How Japan's Secret Weapon in the Global Auto Wars Will Revolutionize the Western Industry*. Macmillan Publishing Company, 866 Third Avenue, New York, 1990