



Industrial Application of Lean Manufacturing

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ABSTRACT

Global competition has led many manufacturing organizations to focus on productivity and quality improvement. One of the effective approaches used to achieve this, is through lean manufacturing. Lean manufacturing is defined as a system based on the philosophy of waste elimination which includes the removal of all non-value added activities from the process of delivering customers' requirement in a manner that delights the customers and ensures they maintain demands. The purpose of this paper is to discuss the related issues in implementing lean manufacturing and the development of this improvement strategy. The results of the study present findings from a company which has implemented lean manufacturing. It showed that many challenges were faced in their operation in order to establish lean manufacturing. The company has their own solution to manage the challenges while improving productivity.

Keywords: *Challenges, lean manufacturing, solutions, wastes*

Introduction

Waste exists in every system. This waste is hidden within all processes may it be from manufacturing to assembly; hospitality, healthcare, transportation, and other social services. There are needs for productivity through waste elimination. Identifying and eliminating this hidden waste saves million of dollars every year for organizations that continuously use "lean" assessments (Wader, 2005). Waste from an Islamic perspective is defined according to the Al-Quran which tells humans that they may use God's gifts for their sustenance in moderation, provided that they commit no excess therein:

"O Children of Adam! . . . Eat and drink: But waste not by excess, for God loves not the wasteful."

(Al- A'raaf: 31)

"...Do not squander (your wealth) wastefully. Surely the squanderers are the fellows of the Devils."

(Al- Israa': 26)

In addition, the Prophet forbade waste even in conditions of seeming plenty when he said:

"Do not waste water even if performing ablution on the bank of a fast-flowing (large) river."

(Hadith Al- Tirmidhi: 427)

This paper is discussed within the context of industrial application of lean manufacturing. It dealt with issues on waste elimination at a composite company which boasts of two years experience in implementing lean manufacturing. Besides, it briefly explains the challenges faced and the solutions used by the company. This paper shall also put forth lean manufacturing tools and techniques which were used to eliminate wastes and improve productivity.

Lean Manufacturing

Since it was introduced, many companies have attempted to implement lean manufacturing (Boyer, 1996). Lean manufacturing is an approach that considers an operation system without waste. Waste elimination in the manufacturing environment is usually deemed in terms of cost reduction which can have a dramatic positive impact on quality improvement. Systematic waste elimination is a cornerstone of lean systems thinking.

Unfortunately, waste elimination is typically viewed as an opportunity to improve efficiency versus the equally important measure of effectiveness. A relentless focus on eliminating waste will have a profound effect on the quality of the service or product provided (Carlino, 2003).

Industrial waste falls into seven basic categories: over production, defects, motion, transportation, inventory, over processing and waiting. These wastes increase cost while adding no value from the customer's perspective. The seven hidden wastes are the enemy of people who are trying to improve processes in all industries (Wader, 2005).

There are many tools of lean manufacturing. Many of the tools can be used together as part of an overall initiative because they compliment each other. Each tool will help remove wastes and reduce the cost of operations.

Although lean manufacturing is the best approach in eliminating waste and improving productivity, it is hard to be implemented. The companies need to have a full commitment from all level of operations including the suppliers and customers. This issue has been considered as problematic for companies which are interested to implement lean manufacturing (Boyer, 1996; MacDuffie, 1997; Power & Sohal, 1997).

The companies should have good knowledge in lean manufacturing tools and their principles while maintaining good relationship with the suppliers. Other problems that should be considered here include lean awareness among production staff, effective communication, transportation systems, delivery performance and customer relationship. Furthermore, the companies must also be prepared to face any problem that might occur in the future towards achieving the so-called successful lean company.

Case Study

A case study was conducted to identify the common problems faced at the initial stage and current stage of lean manufacturing implementation. The chosen company is one of the composite technology leading companies in Malaysia. The company has two years experience in implementing lean manufacturing in their operation system. The company has increased their productivity for approximately 10% by reducing set-up time, job over time, work-in-progress inventory, scrap and rework activities. Therefore, this paper will also describe the solution formula used by the company in order to manage problems in both stages.

Since 2004, the top management of the company has decided to implement lean manufacturing in their operation system while becoming a lean supplier company for their customers. Lean manufacturing policy was created to show top management's commitment towards lean manufacturing. A department called Strategic Development Department (SDD) was formed to organize lean awareness and campaign to staff at all levels. In addition, SDD is responsible to organize internal lean manufacturing training and workshop in terms of principles, basic approach, tools and techniques, seven wastes based on quality, cost, delivery, accountability and continuous improvement targets. Besides, SDD also has a responsibility to monitor all lean activities on the production floor and report the progress to the top management.

The company encourages small continuous improvements and rewards will be given to the teams which contributed value added improvement to the factory. The assessment was made based on monthly productivity and kaizen project that have been performed by the team. Self-Managing Team (SMT) was introduced to encourage every production area to increase productivity and any improvement through empowerment.

Methodology

One of the authors is currently undergoing industrial attachment and has spent almost 6 months researching in the production and operation management system of the company. This study was carried out as part of the tasks in the attachment program. Semi-structured interview was used on the top management. Focus group discussion with fifteen shop floor leaders in the plant and direct observation of the plant in operation were employed to collect primary data. In addition, the interviews not only dwell on the past implementation, but will also focus on the future plans and developments. Secondary data was obtained from company reports, local literature and local newspapers.

In order to gather the data needed for this study attention was given to the following:

- i. How does the company run its manufacturing process?
- ii. What are the challenges faced at the initial stage of lean manufacturing implementation and what are the common solutions used by company?
- iii. What are the preventive methods / approaches used by the company to manage predictable and unpredictable problems?
- iv. What are the factors that could support lean manufacturing practices in the company?

Results and Discussion

The Top Management Perspective On Company Production System

The top management emphasized on the persistent problem that the company faces in the delivery of products to customer. On-time delivery and product quality are the first priority at the company. However, it is still hard to maintain and achieve quality for every product. In addition, work-in-progress products have also contributed to the problem, as the company has a very limited space on the shop floor.

In the past, top management stressed that company should handle the situation by improving communication internally and through discussions with the customers. Besides, the production only focused on the quality of product development strategies and lacked of monitoring at the increasing cost, job over time and product lead time.

The top management also particularly emphasized on other programs via quality, cost, delivery, accountability and continuous improvement (QCDAC) targets through lean manufacturing.

Challenges at the Initial Stage of Lean Manufacturing Implementation

Most of the staff at the beginning was uncomfortable to accept the new manufacturing system. Some of them considered that the new manufacturing system was meaningless and not relevant to the company. In addition, almost 95% from a total of 900 staffs at the shop floor have never heard about the lean manufacturing.

Individuals resisted changes as they have become accustomed to doing a particular process and it has also become their preferred way. It is difficult for individuals to change their way of doing things and thus, it is much more difficult for an organization to make cultural changes. According to Besterfield et al., 2003, changing an organization's culture is difficult and will require as long as five years.

The management understands and realizes the problems. Therefore, there are three basic concepts of change agreed by the management. They are:

- i. People change when they want to and to meet their own needs.
- ii. Never expect anyone to engage in a behavior that serves the organization's values unless adequate reasons (why) have been given.
- iii. For change to be accepted, people must be moved from a state of fear to trust.

Other related problems that lead to the difficulties in implementing lean management are, lack of

training in group discussion and communication techniques, unwillingness towards continuous improvement skills, capability of problem identification, and the problem-solving method used. These are the second most important problems to the company.

In addition, differences between departmental and individuals objectives also created implementation problems. However, the use of multifunctional teams will help to break down these long-standing barriers. Thus, a company restructuring to make the company more responsive to lean manufacturing policy may be needed and individuals who do not embrace this new philosophy may be required to leave the company.

The Solutions Used By Company

Based on the identified problems, both of the top management and the middle management have discussed on what sort of strategies can be used to increase lean awareness among their staffs. Areas such as continuous training and education on lean manufacturing and motivation factors for the staffs were also talked about. A consensus decision is made based on QCDAC targets.

The management which was helped by SDD, organized campaigns, created slogans, and gave speeches that were supposed to motivate staffs on lean manufacturing. "Lean Week" was conducted to promote lean manufacturing and almost all of the staffs were involved. During the Lean Week, the management organized lean games, quizzes and questionnaires were distributed. The staffs also received gifts for their participation. The management then highlighted the benefits and advantages of applying the lean manufacturing approach.

The result of the survey during the Lean Week shows that many staffs positively accepted the change. There were only a few of them who did not agree to the change. To overcome this situation, the management has organized Lean Convention for the staffs. The Lean Convention is considered as a platform for the staffs and the top management to discuss the implementation of lean manufacturing in the company. The management is also responsible to make sure all staffs who attended the Lean Convention will gain proper knowledge and understanding. They then will be able to apply the lean tools and techniques at their production areas.

The Lean Convention is conducted in phases for the focused group. Currently, 20 % out of total 900 staffs who have attended the Lean Convention have strong knowledge about lean manufacturing and are applying their lean knowledge onto their operating system.

With regards to a continuous effort in achieving lean manufacturing in the company, the management has declared that every Wednesday is a Lean Day. All of the company's staffs have to talk about lean and it is their responsibilities to ensure a continuous improvement in their working area.

The management strongly encourages the continuous improvement or kaizen in the company. Since the implementation of kaizen in the production areas in midyear of 2004, there have been a 35% overall reduction in work-in-progress, a 15% overall reduction in cycle times and a 70% overall reduction in job over time. Thus, they have improved their workstation productivity and increased job satisfaction at a little expense without using sophisticated techniques or expensive equipments.

Figure 1 shows the impact of the kaizen approach on the company. Based on Figure 1, if the result from the kaizen project is faster than targeted lead time, the team will be rewarded. If the results are almost similar to the targeted lead time, it is considered as a problem resolution. The approach is not only used for lead time but in all kaizen projects in the company.

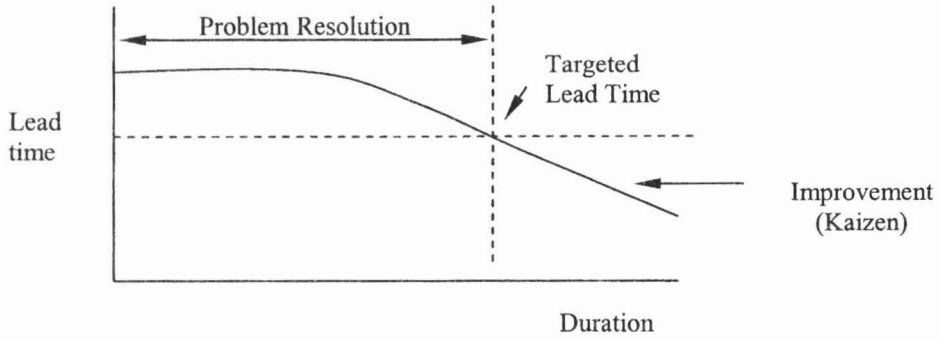


Figure 1: Problem Resolution vs. Kaizen

A total of 7 lean tools were introduced by the management which is considered to be the best techniques to the company in order to eliminate 11 types of wastes. The management has focused on eliminating wastes on matters regarding to time, inventory, material, energy, space, safety, complexity, over production and labor. Table 1 shows the wastes matrix with appropriate lean tools used in the company. The applications of lean tools are preferred as opposed to preventive actions for either predictable and unpredictable wastes or problems.

Figure 2 shows the SOFT matrix analysis of the company. SOFT analysis is used in the company to identify the strengths, opportunities, failure factors and the treatments (the countermeasure of problem solving) of identified problems or failure at the production areas or even at the management level.

Table 1: Wastes vs. Lean Tools

Lean Tools \ Wastes	Time	Inventory	Material	Energy	Space	Transportation	Safety	Complexity	Over production	Labor	Defect
5S		√	√	√	√	√	√	√			√
SMT	√	√	√	√	√	√	√	√	√	√	
Kaizen	√	√	√	√	√	√	√	√	√	√	√
Visual Controls	√	√	√	√	√	√	√	√	√		√
Value Stream Map	√	√	√		√	√		√		√	
Problem Solving Techniques	√	√	√	√	√	√	√	√	√	√	√
Total Productive Maintenance (TPM)	√	√	√	√	√		√	√	√	√	
Six Sigma	√	√	√	√	√	√	√	√	√	√	√

Note: √ = focus point for waste elimination tools

<p><u>Strength</u></p> <p>To show any achievement in manufacturing process</p>	<p><u>Opportunity</u></p> <p>To identify any opportunity in order to improve productivity</p>
<p><u>Failure factors</u></p> <p>To identify the root cause of failure / problem occurred</p>	<p><u>Treatment</u></p> <p>To identify the best solution to tackle any problem</p>

Figure 2: S.O.F.T Matrix Analysis

The Factors that Support Lean Manufacturing Practice in the Company

There are a few factors that influence the implementation of lean manufacturing in the company. The factors are:

Top management commitment.

The top management commitment in the company is considered as the master mind behind the lean manufacturing implementation. They shall influence other staffs to have clear view of lean manufacturing and its implementation. The commitment is shown so that the urgency to implement lean manufacturing in the company is not deemed as a fun matter but all staffs must pay attention and implement it as well.

SDD.

SDD is a department that is responsible for monitoring the journey of lean manufacturing implementation in the company. SDD must conduct all lean activities based on the lean manufacturing policy. SDD is considered as the Lean Facilitator and the medium of communication between the top management and the subordinates. Other than that, the SDD also becomes the internal auditor. It shall present the management with the evaluation on the lean manufacturing implementation at the shop floor. It also has the authority to decide the best SMT for rewarding purposes.

Employee involvement and commitment to change to achieve improvement.

When the management had first introduced the lean manufacturing approach, most of the staffs refused to comply. However, after the management has conducted campaigns, the lean convention and other promotional strategies; there was a positive acceptance from the staffs. They have become committed to change to gain improvement through the lean manufacturing approach.

Effectiveness of lean tools used by company.

The effectiveness of lean tools used in the company also influenced a lot of improvement in the company. The tools that were used focus on eliminating wastes which adds cost and other hidden problems. However, the company is still struggling to ensure the staffs understand and able to use the lean tools in order to eliminate wastes and improve the shop floor. In addition, the company is also trying to explore other lean tools which are useful and easy to be used for decision making and improvement from time to time.

Conclusion

So far, the authors agreed that the company has nearly become a successful lean company because there are a lot of improvements that have been achieved especially in eliminating wastes. However, their 2 year experience in implementing lean manufacturing is not a benchmark to others. The company has to maintain its implementation for at least 5 years in order to produce evidences especially in form of proper documentations. This documentation will show that the company has truly become a successful lean company. Besides, currently there are only 20% out of total 900 staffs who really understand lean manufacturing and are able to apply it. In addition, this study only briefs on the challenges faced by the company and its solution, rather than showing the general implementation from the beginning until now. This study also does not cover the role of lean supplier in order to improve the company implementation of lean manufacturing. However, the authors can conclude that the implementation of lean manufacturing is a good approach to all companies in any industries. The results from this study shows that company have improved their productivity and continuously encourage their staffs for improvement. Although the implementation of lean manufacturing has many challenges, there are many solutions that can be taken into account.

Acknowledgements

The authors would like to thank Universiti Teknikal Malaysia Melaka (UTeM) for allowing Mr. Wan Hasrulnizam bin Wan Mahmood to undergo the Industrial Attachment program.

References

- Besterfield, D. H., Minhna, C. B., Besterfield, B. H., & Sacre, M. B. (2003). *Total quality management (3rd Edition)*. Prentice Hall: New Jersey.
- Boyer, K.K. (1996). An assessment of managerial commitment to lean production. *International Journal of Operations and Production Management*, 16(9), 48-59.
- Carlino, A. (2003). *Improving quality through waste elimination*. Retrieved November 12, 2007, from http://www.findarticles.com/p/articles/mi_qa3618/is_200309/ai_n9253653.
- MacDuffie, J.P. (1997). The road to "root cause": Shop-floor problem-solving at three auto assembly plants. *Management Science*, 43(4), 210-221.
- Power, D.J., & Sohal, A.S. (1997). An examination of the literature relating to issues affecting the human variable in just-in-time environments. *Technovation*, 17(11/12), 649-666.
- Wader, M. (2005). *Lean tools: A pocket guide to implementing lean practices*. Madras: Productivity & Quality Publishing Private limited.

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