

## INDUSTRIAL APPLICATION OF LEAN MANUFACTURING

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### ABSTRACT

Global competition has led many manufacturing organisations 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, the removal of all non-value added activities from the process of delivering a customer's requirement in a manner that delights the customer and ensures they maintain orders. The purpose of this paper is to discuss the related issues in implementing lean manufacturing and the development strategy of improvement. The results of the study carried out on a company which had implemented lean manufacturing 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 improve productivity.

**Keywords:** *Lean Manufacturing, Wastes, Challenges, Solutions*

### Introduction

Some waste exists in every system. From manufacturing and assembly, to hospitality, healthcare, transportation, and social services, some waste is hidden within all processes. There are the needs for productivity through waste elimination. Identifying and eliminating this hidden waste saves million of dollars every year for those organisations that continuously use "lean" assessments (Wader, 2005). Wastes from Islamic perspective, the Al-Quran 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 wasters."*

(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 the industrial application of lean manufacturing in eliminating waste at composite company with two years experience in implementing lean manufacturing. Beside, it briefly explains the challenges faced and the solutions used by the company and lean manufacturing tool and techniques 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, usually thought of in terms of cost reduction, can have a dramatic positive impact on improving quality. 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).

This waste falls into seven basic categories: over production, defects, motion, transportation, inventory, over processing and waiting. These waste increase cost while adding no value from the customer's perspective. The seven hidden wastes are the enemy of people 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 have to have a full commitment of all level of operation include suppliers and customers. This issue has been considered as a problem for companies which are interested to implement lean manufacturing (Boyer, 1996; MacDuffie, 1997; Power and Sohal, 1997).

The companies should have good knowledge in lean manufacturing tools and their principles while maintaining good relationship with suppliers. Other problems that should be considered here including lean awareness among production staff, effective communication, transportation systems, delivery performance and customer relationship. Furthermore, the companies also must 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 initial stage and current stage implementation of lean manufacturing. The chosen company is one of the composite technology leading companies in Malaysia. The company has 2 years experience in implementing lean manufacturing in their operation system. The company had increased the productivity approximately 10% by reducing set-up time, job over time, work-in-progress inventory, scrap and rework activities. Furthermore, this paper will describe the solution formula used by the company in order to manage problems in both stages.

Since 2004, top management of the company has decided to implement lean manufacturing at operation system while become 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 level. In addition, SDD is responsible to organize internal lean manufacturing training and workshop in terms of principles, basic approach, tools and techniques, 7 wastes based on quality, cost, delivery, accountability and continuous improvement targets. Besides, SDD also has a responsibility to monitor all lean activities in production floor and report the progress to top management.

The company encouraged small continuous improvements and rewards will be given to the team which contributed value added improvement in 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 top management. Focus group discussion with 15 shop floor leaders in the plant and direct observation of the plant in operation were employed to collect primary data. In addition, the interviews were conducted 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:

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

### **Results And Discussion**

#### ***Top Management Perspective On Company Production System***

The top management emphasized the persistent problem company faces with delivery of products to customer. On-time delivery and product quality which are first priority at the company, are still hard to maintain and difficult to achieve for every product. In addition, work-in-progress products also contributed to problems for the company with its limited space at the shop floor.

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

The top management 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 in the beginning were 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 never heard about the lean manufacturing at the first stage.

Individuals resisted change and they became accustomed to doing a particular process and it becomes preferred way. It is difficult for individuals to change their way of doing things and it is much more difficult for an organization to make a culture change. According to Besterfield *et. al*, 2003, changing an organization's culture is difficult and will require as much as five years. Management understands and realizes that problems occurred. There are basic concepts of change agreed by management:

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

In addition, lack of training in group discussion and communication techniques, continuous improvement skills, problem identification, and the problem-solving method were the second most important problems in the company. Besides, differences between departments and individuals were created implementation problems. The use of multifunctional teams will help to break down long-standing barriers. Restructuring to make the company more responsive to lean manufacturing policy may be needed. Individuals who do not embrace the new philosophy can be required to leave the company.

### ***The Solutions Used By Company***

Based on the identified problems above, both of the top management and middle management were discussed what sort of strategies can be used in increasing lean awareness among staffs, continuous training and education on lean manufacturing and motivation factors for staffs. A consensus decision is made based on QCDAC targets.

Management which helped by SDD, organized campaigns, slogans, and speeches that were suppose to motivate staffs on lean manufacturing. "Lean Week" was conducted to promote lean manufacturing and almost all the staffs have been involved. During the Lean Week, management organized lean games, quizzes and questionnaire survey while the staffs received a gift of participation. Management were also highlighted the benefits and advantages of lean manufacturing to the company.

The result of the survey during the Lean Week shows that many staffs positively accepted the change towards lean manufacturing. Only a few of them did not agree with the change.

Thus, management has organized Lean Convention for staffs. The Lean Convention is considered as a platform for staffs and top management to discuss the implementation of lean manufacturing in the company. Management is also responsible to make sure all staffs who attended the Lean Convention to have proper knowledge, understanding and able to apply the lean tools and techniques at their production areas. However, Lean Convention is conducted by phases for the focused group staffs. Currently, 20 % out of total 900 staffs who have already attended the Lean Convention have strong knowledge about lean manufacturing and applied their lean knowledge in the operation system.

Regards as a continuously activity on lean manufacturing in the company, management have declared that every Wednesday is a Lean Day and all staffs have to talk about lean and its continuous improvement at their own responsibility areas.

The management strongly encourages the continuous improvement or kaizen in the company. Since implementing 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. In addition, they had improved their workstation area and increase job satisfaction at little expense without sophisticated techniques or expensive equipment. Figure 1 shows the kaizen approach at the company by using a graph. 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 only near to targeted lead time, it is considered a problem resolution. The approach is not only used for lead time but all kaizen projects in the company.

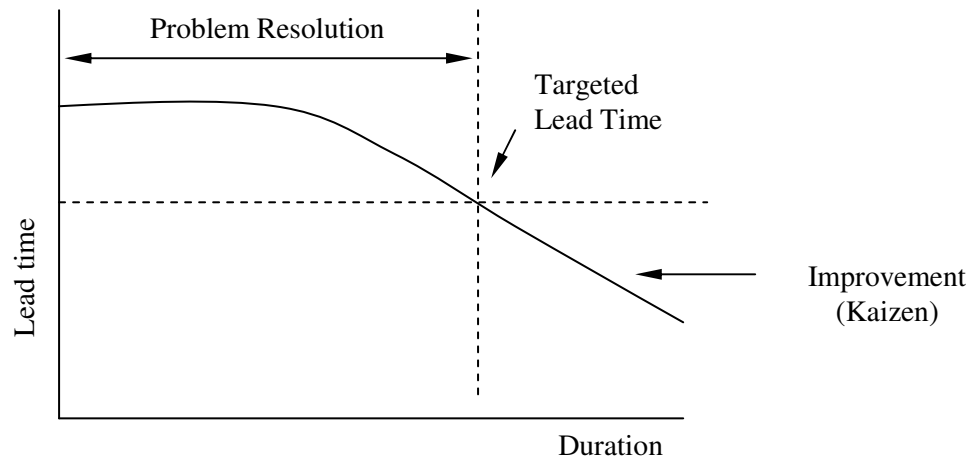


Figure 1: Problem Resolution vs Kaizen

A total of 7 lean tools were introduced by management which considered the best techniques to the company in order to eliminate 11 types of wastes. Management has considered that company focus on eliminating wastes in time, inventory, material, energy, space, safety, complexity, over production and labour. Table 1 shows the wastes matrix with appropriate lean tools used in the company. Applications of lean tools are preferred to preventive action for either predictable and unpredictable wastes or problems.

Figure 2 shows the SOFT matrix analysis in 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 problem or failure at the production areas and management level.

Table 1: Wastes vs Lean Tools.

Lean Tools	Wastes										
	Time	Inventory	Material	Energy	Space	Transportation	Safety	Complexity	Over production	Labour	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><b><u>Strength</u></b> To show any achievement in manufacturing process</p>	<p><b><u>Opportunity</u></b> To identify any opportunity in order to improve productivity</p>
<p><b><u>Failure factors</u></b> To identify the root cause of failure / problem occurred</p>	<p><b><u>Treatment</u></b> To identify the best solution to tackle any problem occurred</p>

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

***The Factors that Supported Lean Manufacturing Practice in the Company***

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

1. Top management commitment.

Top management commitment in the company is considered the master mind of the lean manufacturing implementation. It's influenced other staffs to have clear view of lean manufacturing and the implementation. The commitment is showed that the implementation of lean manufacturing in the company is not for fun but all staffs member must pay attention and implement it.

## 2. SDD.

SDD is a department that is responsible to monitor the journey of lean manufacturing implementation in the company. SDD conducted all of lean activities based on the lean manufacturing policy. SDD is considered as a Lean Facilitator and the medium of communication between top management and the organization. Besides, SDD becomes the internal auditor to represent the management in order to evaluate the lean manufacturing implementation at the shop floor and has the authority to decide the best SMT for rewarding.

## 3. Employee involvement and commitment to change towards improvement.

Since management has introduced lean manufacturing, most of the staffs refused to comply. However, after campaign, lean convention and other promotion strategies were conducted by management; the results show the positive acceptance by staffs and become committed to change towards improvement through lean manufacturing.

## 4. Effectiveness of lean tools used by company.

Effectiveness of lean tools used in the company are also influenced a lot of improvement in the company. The tools that were used focus on eliminating wastes which adds cost and hidden problems. However, the company 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 tried to explore the others lean tools which are useful and easy to use for decision making and improvement from time to time.

## **Conclusions**

So far, the authors agreed that the company has nearly become a successful lean company because a lot of improvements have been done especially in eliminating wastes. However, 2 year experience in implementing lean manufacturing still cannot be a benchmarking company to others. The company has to maintain the implementation at least 5 years with the evidence to show the company truly successful lean company in proper documentation. Besides, currently only 20% from out of total 900 staffs who are really understand lean manufacturing and able to apply the application on the floor. In addition, this study only brief on the challenges faced by the company and its solution, and does not shows the general implementation starting 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 concluded that implementation of lean manufacturing is a good approach to all companies in any industries. The results from this study show that company had 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 to solve them.

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