A Lean Manufacturing Framework for the Malaysian Electrical and Electronics Industry

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Abstract. Lean manufacturing has penetrated to most of the manufacturing sectors across the globe. It has been regarded as a remedy to survive and be competitive in this global market. Despite this, limited research has been done in Malaysia especially in the electrical and electronics industry. Although models and frameworks have been developed, a little has been done to assist the Malaysian electrical and electronics industry to implement lean manufacturing. This paper presents a framework that serves as a guideline to implement lean manufacturing in this industry. The framework was developed through case studies conducted in four electrical and electronics companies in Malaysia.

Keywords: Lean manufacturing, Framework, Electrical and Electronics, Malaysia

1. Introduction

Lean manufacturing has gained a great deal of attention in diverse sectors especially in the automotive sector. It has been seen that manufacturers somehow need to be “lean” in order to survive and become competitive. The fierce competition in the market has changed the way organizations look at profit. They understood that there is no other option other than to reduce cost in order to make profit and survive in the global market. Hence, they have to be efficient in what they are doing by eliminating waste.

For this reason, many manufacturers have engaged themselves in lean programs to achieve business excellence. Despite this, there are a limited number of studies conducted in Malaysia especially in the electrical and electronics industry. In an attempt to assist companies in this industry to implement lean manufacturing, this paper proposes a framework which is believed to be suitable and useful for them.

The framework was developed after conducting case studies in four electrical and electronics companies. Common practices from the case studies were generalized and combined with ideas from the literature to become a framework. It is hoped that this framework would provide an important insights and guidance to the Malaysian electrical and electronics industry to implement lean manufacturing.

The paper begins with an overview of the research background. The next section describes the lean manufacturing framework and finally, the paper culminates with conclusions.

2. Background of the Research

Lewis [1] stated that lean core principles have become the paradigm for many manufacturing operations. Both researchers and practitioners agreed that lean manufacturing if adopted and carefully implemented can undoubtedly form the roadmap to global manufacturing excellence [2]. Today, lean manufacturing is an integrated system which is structured with collective elements and practices including Just-in-time, work teams, quality systems, cellular manufacturing, etc. [3].
Anand and Kodali [4] claimed that many lean manufacturing initiatives have failed due to the lack of its understanding by managers and employees. Therefore, a lean manufacturing framework that integrates the practices in different areas is required to allow practitioners understand clearly the requirements for implementing lean manufacturing.

The lean manufacturing implementation framework was developed by conducting case studies in four electrical and electronics manufacturers in Malaysia. The details of the companies are shown in Table 1.

<table>
<thead>
<tr>
<th>Company</th>
<th>Main products</th>
<th>Years in lean manufacturing</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Electro mechanical tools</td>
<td>5</td>
</tr>
<tr>
<td>B</td>
<td>PCBA assemblies</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>Integrated circuits</td>
<td>3</td>
</tr>
<tr>
<td>D</td>
<td>Relays and keyboards</td>
<td>5</td>
</tr>
</tbody>
</table>

The companies selected for the case studies are experienced in implementing lean manufacturing. They were chosen because they have gone through the processes and hardship to employ lean manufacturing in their own organization. This allows other organizations to learn from their experiences and success stories so that pitfalls can be avoided when implementing lean manufacturing. The case studies focused on several points that are: methods to kick start and execute lean manufacturing across the organization, application of lean tools and techniques, its major obstacles as well as ways to solve them.

Common practices obtained were then generalized and coupled with literature review to construct a framework. The framework includes steps to implement lean manufacturing, key areas for lean improvement, and suggestions on the usage of lean tools as well as sequence in implementing the tools. The framework was evaluated by the companies and modifications were made in order to increase its usefulness.

3. Lean Manufacturing Framework

According to Hakes [5], a sound framework links concept with practical application through some systematic means. Deros et al. [6] stated that a framework is a set of simplified theoretical principles and practical guidelines which is easy to understand, efficient and can be implemented. Therefore, it is believed that a framework can help and act as a guide in the implementation process [7].

Figure 1 illustrates the proposed lean manufacturing implementation framework. The framework consists of 3 parts; the first part is the foundation, where it serves as a basic condition for improvement to be carried out. The second part is the improvement practices that start with the current state to the defined ideal state. The third part is the outer circle which indicates continuous improvement in the 13 key areas of lean manufacturing.

Lean principles must firstly be understood before implementing lean manufacturing. The whole framework structure is underpinned by the five lean principles which are: specify value, identify the value stream, flow, pull, and pursue perfection [8]. Prerequisites for lean manufacturing include stability, standardization and discipline. Without stability, it is impossible to produce a reliable product due to variations in materials, equipment performance, working methods and skills of employees, and quality from vendors [9]. Standardization aims to help people to be more effective. It emphasizes on a normal pattern of performing work that includes takt time, specific sequence or activities and defined work-in-process inventory [10]. In addition, discipline is required to follow the principles and rules of lean manufacturing when carrying out the daily tasks.

Before improvement process is commenced, the current state has to be defined. Next, a vision of a future state needs to be proposed and developed. Three constructs have been proposed in order to carry the current situation to the proposed future state. They are: people, think lean and act lean. The arrows among the interdependent constructs represent the flow between the constructs. Each of the constructs is supported by some lean tools and techniques or activities.
People are the key for a successful lean initiative. Managers and workers need to work hand in hand in order to achieve the organizational goal. At the outset, top management must be fully committed in lean manufacturing starting by understanding the concept of lean manufacturing and the benefits it will bring to the company. Mission and vision need to be created by top management and shared among the team members. Time and effort need to be invested to train the employees to become competent and be aware of waste as well as be more sensible in doing their works. Trainings and workshops are a must to educate the employees about the principles and fundamentals of lean manufacturing. The leaders should always practice what they preach and lead by example so that workers under them can have a better understanding about lean manufacturing and emulate the way leaders do thing. Building effective teams is also crucial in lean manufacturing. Certain criteria are required in an effective team namely openness, sincerity, respect, trust and also interdependence. Team members which have openness can accept different views and respect other people’s opinions. They can communicate and exchange values and beliefs pleasantly as the “fear factor” is absent. With proper communication and understanding regarding lean manufacturing, the workers will be able to visualize the needs and the benefits of the changes required. Nevertheless, support and motivation is needed to motivate them to give more ideas for improvement. Other than that, feedbacks from the workers allow the real situation to be better understood by the managers. This provides counter measures that can decrease resistance and increase empowerment. In addition, a suggestion scheme as well as a new reward and recognition system could be implemented to encourage empowerment.

The next construct ‘think lean’ is to have the mindset based on lean principles. Lean manufacturing requires systematic problem solving methods. Problems should be treated as opportunities because they can reveal the weakness of the current situation [11]. In order to grasp the real situation and define the problem, one has to go to the real place and see what is really happening there. This behavior is called Genchi Genbutsu. After the problems have been defined, waste needs to be eliminated as well as the root cause. Utilizing the 5 whys method enables problems to be determined as closely to the root cause to prevent the
problems from reoccurring. Decision to make improvement should be made by consensus after considering all options. Action to eliminate the problems should be taken as fast as possible with a sense of urgency while keeping it simple and clear. It must be noted that lean manufacturing is a never ending journey where there is no end for continuous improvement. After reaching one target condition, it will become a benchmark for the next target. In order to keep going with continuous improvement, persistence must be cultivated in every employee’s heart.

The third construct ‘act lean’ implies that lean needs to be learnt by doing. A challenge can be thrown to employees to eliminate the wastes at the work place. 7 major wastes identified are overproduction, waiting, transportation, incorrect processing, excess inventory, unnecessary movement, and defects. Pilot test can be employed as a learning platform to try out the new ideas for improvements. Changes should be implemented one at a time so that experiments can be conducted and the early success or drawback can be studied. Each value stream flow should be specified and optimized to create a continuous flow. With visual control, work can be understood at a glance and transparent to others. Lean tools can be utilized as enablers to achieve the ideal state as well as support the overall strategy of the organization. Value stream mapping can be employed as a starter to map the current value stream to identify points for improvement. A more advanced tool such as kanban to create a ‘pull’ flow can be implemented after the line has been balanced. The function of the lean tools and the reason for applying them must be known before they are implemented as different conditions and different problems require different tools.

Key areas of lean manufacturing identified are: scheduling, inventory, material handling, equipment, work processes, quality, layout, employees, suppliers, customers, safety and ergonomics, management and culture, and product design [12] [13]. These key areas are not equally critical as they depend on the nature of business. They can be improved depending on the priority of the management in every company. Finally, the circle signifies that lean is a never ending journey that keeps going on, with the arrows on the circle indicating continuous improvement. People need to think and act lean consistently and persistently to achieve excellent results. Starting with little and keep doing it could expand it into a way of life in the whole organization. As the behavior of people to ‘think lean’ and ‘act lean’ is shared widely across the organization, it becomes the lean culture of the organization.

4. Conclusions

Companies that are keen to adopt lean manufacturing need to understand what is required and how to implement it. They have to carefully judge which lean practices and tools can be adopted to suit their overall strategy. It is noted that lean manufacturing cannot be done overnight. It requires full commitment and great effort to ensure its success. This paper has shown how lean manufacturing can be adopted in the electrical and electronics industry by providing the practices and the tools for improvement. Further research can be done to test the framework practically in order to refine the present model.

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6. References


