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Implementation of Lean Manufacturing for Productivity Improvement in Malaysia

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Abstract—In Malaysia, Lean manufacturing is a unified system that entailed with a set of philosophies, rules, guidelines, tools and techniques which imposed to eliminate significant waste in all business processes for continuous improvement. However, limited studies and publication about lean manufacturing implementation have been done in Malaysia. A single case study method was applied in this study to explore the key success factors and process of lean implementation. Primary data (interview) was collected from related field experts and the results gained was further analyzed by using Nvivo 10 software. Further discussion was made with the assistance of secondary sources. Moreover, two types of lean assessment tools, value stream mapping and gap analysis were applied to assess the current manufacturing system of the selected company for the purpose to enable to present a positive lean measurement of the selected company to support the identified objectives.

Keywords: lean manufacturing, productivity improvement, continuous improvement, electrical and electronics company, lean assessment tools.

I. INTRODUCTION .

This chapter describes an overall framework of the study. It aims to deliver succinct and concise concepts of the study to the readers. The subtitles embodied in this chapter are background of study, problem statements, research questions, research objectives, research scope, limitation of study, significance of study, organization of chapters and end with the summary for overall chapter. This study is to explore an electrical and electronics company in Batu Pahat, Johor that has known to implement lean manufacturing successfully. Lean manufacturing is a unified system that entailed with a set of philosophies, rules, guidelines, tools and techniques which imposed to eliminate significant waste in all business processes for continuous improvement. It is pioneered by Eiji Toyoda, Taiichi Ohno and Shigeo Shingo from Toyota Motor Corporation (TMC), Japan. [8] emphasized that the key principles of lean manufacturing composed of value, value stream, flow, pull and perfection. The key principles can be summarized as the combination of recognition of waste, standard processes, continuous flow, pull-production, quality at the source and continuous improvement. Since the last three decades, many reading materials such as journals, articles and books related to lean manufacturing in terms of concepts, tools

and techniques, implementation, etc have been published worldwide. Therefore, the significant positive impacts from the sources encouraged manufacturers to embark lean. Due to the rapid fluctuations of today's global economic and highly competitive market place, many companies in Malaysia especially electrical and electronics keen to implement lean for business excellence as well.

A. Problem statements

The first issue here is that the current implementation of lean manufacturing failure rates are as high as over 50 percent according to many lean advocates and professionals. Many have implemented lean manufacturing but did not attained the goals [3].The second issue is about the transparency of the implementation of lean manufacturing in Malaysia' industries. Case study of lean in Malaysia industry is limited and hardly found based on [1].

B. Research Objectives

The objectives that toward accomplishing this study are :

- To assess the current manufacturing system of the selected company.
- To identify the key success factors for lean implementation that impact on productivity improvement in electrical and electronics company in Batu Pahat, Johor.
- To identify the lean manufacturing implementation processes that impact on productivity improvement in electrical and electronics company in Batu Pahat, Johor.

II. LITERATURE REVIEW

A. History of Lean Manufacturing

Lean manufacturing was originated founded by Toyota Motor Corporation (TMC) in Japan. In end of 1940s, Toyota was facing severe cash flow problem due to the shortages of raw

materials, financial and workforce after World War II that nearly caused the company filed for bankruptcy. The pioneers of lean manufacturing, Eiji Toyoda and Taiichi Ohno had made a remarkable change and historical twist for Toyota at that critical period. The succeed development of Toyota Production System (TPS) caught the attention from the western industries. The study of the Massachusetts Institute of Technology (MIT) about the concept of lean manufacturing and significant difference between the traditional mass production and lean manufacturing credited to more western industries embarked on lean manufacturing. Toyota Production System (TPS) was then rephrased as “Lean Manufacturing” by [9] in the book “The Machine That Changed The World”. The term “Lean Manufacturing” is popularized by [9]. Lean manufacturing uses less of everything compared to western mass production. It is a production system that focuses on reducing waste in all the business processes. Waste is best described as any non-value added activities which customers unwilling to pay for. It is also known as an integration system composed of wide range of management practices, tools and techniques such as Just-in-time, cellular manufacturing, kaizen, etc.

B. Lean Manufacturing Tools and Techniques

Lean manufacturing offers various tools and techniques to tackle and identify different types of waste effectively and improve efficiency in different situations [10]. The most often tools and techniques adopted in Malaysia are 5S, Kaizen, Standardized work, Plan-Do-Check-Act (PDCA), Poka-yoke, Kanban, Just-in-Time (JIT), Total Productive Maintenance (TPM) and Value Stream Mapping (VSM).

C. Critical success factors of Lean Manufacturing Implementation

Several researchers have developed their own studies to assess the critical success factors of lean manufacturing implementation. One of the prior study has identified four critical success factors which included leadership and management, financial, skills and expertise and supportive organizational culture of the organization [2]. The studied done by [6] argued that the factors are related to process management, lean improvement culture, lean degree of employee and adoption ability.

III. RESEARCH METHODOLOGY

A. Sample

[4] defined sample as the representative of the population from which it is selected if the characteristics of the sample is approximately parallel to the characteristics of the population. The sampling method employed in this qualitative study is adopted from the useful typology sampling strategies proposed by [5] which is theoretical sampling. Theoretical sampling refers to the study processes based on the previous

constructed theory and comparison is made. The sample for this study is represented by the employees from the targeted electrical and electronics company which located in Batu Pahat, Johor.

B. Research Instruments

In this study, three research instruments are employed to accomplish the study. First instrument is the research whereby the researcher played the role as interviewer, listener and observant at the same time. Second instrument is interview. According to [7], interviews can provide more of an insight into the meaning and significance of what is happening than other instruments. An effective interview flow chart recommended by [7] is used as reference. The flow started with drafting the questions, piloting the questions, selecting the interviewees, conducting the interviews and lastly analyzing the interview data. The third instrument used is audio recorder to record the whole verbal conversation.

C. Data Collection

For data collection, there will consist of two types of data that will used in this study. The types of data involved are primary data and secondary data. The information will be gained from both of this resource.

D. Data analysis

The conducted lean assessments only focused on keyboard production department due to time constraints. The main purpose of the assessment is to assess the current manufacturing system of Company X. The expected positive lean results would able to prove the company is currently succeed in initiating Lean Manufacturing implementation which would also increase the reliability of this study since both of the objectives are related to the key success factors and implementation process of lean. Two types of lean assessment tools applied in this study which are value stream mapping (VSM) and gap analysis.

There are two types of VSM which are current state VSM and future state VSM. Only the current state VSM will be constructed in this study due to time constraints. The current state VSM illustrated the flows of raw materials transform into finished goods and finally shipping to customers in visual form. Gap analysis will be focused on accessing 10 specific areas at the manufacturing site. The assessment will be done by 10 experience’s managers. The average scores will be presented in a gap analysis chart.

IV. DATA ANALYSIS

In this chapter, all the collected data will be analyzed and the results will be explained in detail. The data analysis will be divided into two domains. First domain focused on analyzing the Lean Manufacturing assessments’ results. Whilst second domain will be focused on achieving the identified objectives as stated in the beginning of the study by analyzing the

transcription data from the conducted interviews. Upon all the collected data, the qualitative data collected from interviews will be analyzed by using Nvivo 10 software. In the software, the qualitative data will be coded under the related nodes and the results are next presented in visual forms such as tree node and tree map. The references and coverage of the data are summarized and next presented in table. The Gap Analysis data which in the scoring form will be arranged and calculated by using Microsoft Excel. The average scores for each area will be computed and presented in a gap analysis chart. AutoCad version 2007 will be used to draw and illustrate the current state value stream map based on the collected manufacturing process data.

A. Gap Analysis

In this Gap Analysis audit, it will present an overview of the company’s current manufacturing system in 10 specific areas which included order leveling, material flow, flow manufacturing, training, team involvement, visual controls, quality, Total Productive Maintenance (TPM), Quick changeover and workplace organization. Average scores for each section of the assessment by 10 managers are shown in table below:

Table 4.1: Average Scores For Each Section of the Assessment

Section	Total Section Points (x)	Section AVG (x/10) = y	Section % (y/5)
Order Leveling	43	4.30	86%
Material Movement	45.12	4.51	90%
Flow Manufacturing	43.85	4.39	87.80%
Training	42.2	4.22	84.40%
Team Involvement	43.25	4.33	86.60%
Visual Controls	39.75	3.98	79.60%
Quality	40.83	4.08	81.60%
Total Productive Maintenance (TPM)	39.17	3.91	78.20%
Quick Changeover	41.5	4.15	83%
Workplace Oragnization	43	4.30	86%

From table 4.1, average score and percentage for each area is computed. Material Movement with the highest average score of 4.51 while TPM received the lowest average score, 3.91 only which indicated it is the weakest area among all and improvement is needed in that area. Next, the following table demonstrated the audited final average scores for each section with comments.

Assessment Type	Comments	Average Score
Order Leveling	<ul style="list-style-type: none"> Unclear takt image. Good utilization of Heijunka box and pitch. 	4.30
	<ul style="list-style-type: none"> Goods are delivered to the point of use and 	4.51

Material Movement	<ul style="list-style-type: none"> on time delivery is over 98% Standard pack systems are fully implemented. Operators do not have to leave their workplace to pick up and deliver materials. Pull system is implemented but still need continuous improvement. 	
	<ul style="list-style-type: none"> The value stream concept is well understood in the workplace. Supermarkets and continuous flow are in full usage Standardize work is fully developed Takt time had been calculated. 	4.39
Training	<ul style="list-style-type: none"> There is employee-training plan exists. The workforce is fully skilled with cross-trained and certified, and a rotation system in place. Workforce is accesses to the continuous improvement courses and tools Lack of documentation of the training held. 	4.22
Team Involvement	<ul style="list-style-type: none"> Workforce is confident in the company. The workforce is well educated with the seven wastes. There is no improvement suggestion plan in place 	4.33
Visual Controls	<ul style="list-style-type: none"> Visual control signals are easy to understand and standardized throughout the workplace. Visual control signal is carried out manually. 	3.98
Quality	<ul style="list-style-type: none"> Fully implementation and documentation of measurement and test equipment maintenance and calibration process. Inspections are incorporated into the processing at the workstations. Process of capability and stability are unknown 	4.08
Total Productive Maintenance	<ul style="list-style-type: none"> Machine breakdowns are immediate report and response. Maintenance metrics are not fully in use 	3.91
Quick Changeover	<ul style="list-style-type: none"> Set-up and changeovers are improved based on value stream plans. Set-up and changeover tooling is well-organized, using visual controls and immediately available. 	4.15
Workplace Organization	<ul style="list-style-type: none"> The workstations are well organized after implemented 5S. There is 5S audit every week to ensure the continuous improvement. 	4.30
TOTAL LEAN ASSESSMENT		42.17/50
AVERAGE TOTAL LEAN ASSESSMENT		4.22

In this case, average total lean assessment score is 4.22 which considered as good compared to the scale. This implied that Company X’s effort in executing Lean Manufacturing implementation had led to positive results which means they are considered succeed in initiating the whole implementation activity. Based on the Gap Analysis, the company can summarize the underlying structural issues that need to be addressed in the future and make continuous improvement in the specific aimed area. According to the chart, total productive maintenance (TPM) received the lowest average score with 3.91 due to the maintenance metrics are not fully in use. This also implied that TPM categorized as the area that need to be concerned the most.

B. Value Stream Map

The current stream map is visualized based on the collected data such as flow chart and manufacturing process data.

Table 4.5: Manufacturing Process Data of Final Assembly Line

	Process	Cycle Time (secs)	Standard Time (secs)	Change-over Time (secs)	Operator
01A	Insert Link	26	30	0	1
01B	Input KB & Keytop Lift Up Check 1	39	60	0	1
02	Keytop Lift Up Check 2	29	30	0	1
03	Riveting & Keytop Appearance 1	26	30	0	1
04	Keytop Appearance 2	24	30	0	1
05	Keypress 1	28	30	0	1
06	Keypress 2	29	30	0	1
07	Function Test	34	30	0	1
08	Bezel Riveting	31	55	0	1
09	LGP Sheet Affixing	24	25	0	1
10	Black Tape & Label Affixing	21	20	0	1
11	LGP Function Check	18	20	0	1
12	Keytop Appearance 3	28	30	0	1
13	Keytop Appearance Check (KAC)	29	30	0	1
14	KB Packing	32	30	0	1

Based on Table 4.5 above, all of the changeover time is 0 due to all the performing tasks at final assembly line are done in a stream line whereby there is none of interruption caused by machine switching. After obtaining the process flow of keyboard and manufacturing process data of final assembly line, the current stream map is illustrated in figure 4.2.

C. Node Summary

The developed nodes are covered the two identified objectives of the study. Firstly, the nodes covered under first objective, key success factors of lean implementation can be observed that the sources can be found in all 7 interviewees and also cited a total of 33 references from the conversation of the transcription. Meanwhile the nodes of the Lean Manufacturing processes that impact on productivity improvement can be seen too whereby all 7 of the interviewees were set to have a total of 66 references to be quoted out from the transcription of their conversation.

Table 4.6: Summary result of noding

Main Node	No of Subnodes	Sources	References
Key Success Factors	10	7	27
Process	5	7	65

D. Coding Summary

Table 4.7: Summary result for coding

Interviewee	Key Success Factors		Process	
	Total References	Coverage (%)	Total References	Coverage (%)
A	6	32.17	9	42.47
B	3	20.83	9	43.03
C	4	31.97	10	37.35
D	3	23.65	10	37.68
E	3	25.31	9	31.05
F	3	26.16	9	34.99
G	5	28.07	9	37.63

The table above shows that interviewee A with highest coverage of 32.17% for key success factors. Whilst for implementation process, interview B with the highest coverage of 43.03%. Highest coverage indicated that the most references coded under that particular title. Lean implementation process Furthermore, the tabulation of key success factors are presented in the chart below. The number of interview versus key success factors are shown in Figure 4.1.

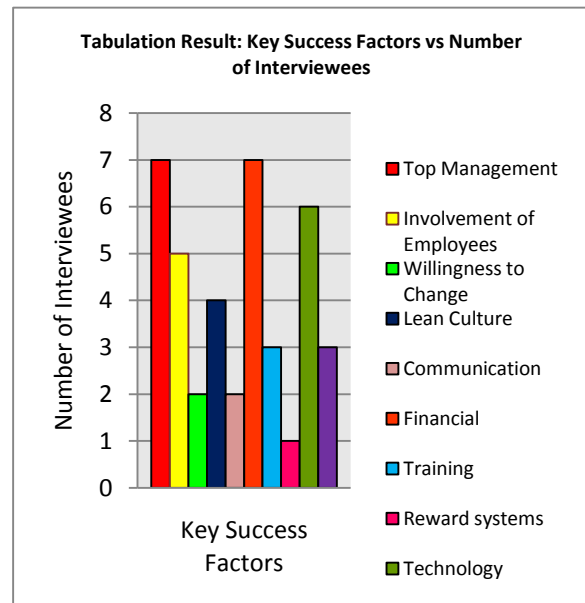


Figure 4.5: Tabulation result: Key Success Factors versus Number of Interviewees in chart.

V. DISCUSSION ON FINDING

First of all, the results from the lean assessments were as expected whereby the results were positive enough to prove that the selected company is successful in initiating Lean Manufacturing implementation. The total average score for gap analysis in 10 specific aimed areas are 4.22 out of 5 which strengthen the fact of their successful implementation. Lean manufacturing tools such as pull systems and supermarket can be seen clearly from the current map. *Kanban* is applied as well in the supermarket. While based on the results of the previous interviews' transcription, 10 key success factors were identified which included top management, involvement of employees, willingness to change, lean culture, communication, financial, training, reward system, technology and suppliers. Top management is known as the most critical success factor in lean implementation as concluded from 7 interviews. This is due to top management is known as the prime mover with the highest authority in the lean project and he is the one that determines the success of the implementation. Therefore, top management must harbour strong leadership skills with strong commitments and high determination. Besides that, an outstanding lean leader should characterize with discipline, integrity and encouragement in order to lead the subordinates to the success path.

Furthermore, employees are the core of the success. Therefore, their involvement is very important. In lean implementation project, everyone from top to down must involved to achieve success. Without the cooperation from all parties, the project failed. The cooperation also means everyone must has the willingness to change instead of being reactive and resist to change. To make everyone in the organization to follow the lean project and change themselves, communication is another important factor. In this case, the management team must communicates well with other employees in terms of delivering the lean knowledge in the right ways. Factors of involvement of employees, willingness to change and cooperation among all level employees will lead to positive lean culture. Lean culture is an essential platform for the lean implementation project.

Financial capacity is crucial in determining the success rate of the implementation project. Financial resources are required to hire lean consultants if necessary, provide training to workforce, aid for new equipments or technology, reward systems etc. The reward system is the catalyst for the employees. The employees that perform well and willing to cooperate should be rewarded so that they will feel that their hard works are being appreciated and have the sense of belonging to the company. Moreover, in order to support the lean project, the company should has high quality technology as an advance to support their lean project. The employees should be well-trained so that they are able to possess high-skills and expertise to handle complicated processes that involved high technology. Lastly, suppliers are important too and they cannot be ignored. A good lean organization always educate their suppliers and treat them as partners in order to execute the implementation project successfully. Next, the identified processes that lead to the successful Lean

Manufacturing implementation is discussed. Firstly, the company is motivated by the head quarter in Japan to implement Lean Manufacturing due to the intense competition in the marketplace. In the initial stage, the head quarter hired two consultants from Japan to mentor and educate them with lean knowledge. Next, they determine the key area for improvement and wastes to be eliminated. After that, suggestions on the usage of tools and techniques were made and first pilot test was carried out. The first pilot test took approximately 2 weeks to complete. Once it completed, the assessment and feedback were made for continuous improvement. After the first pilot test had completed with positive results, Lean Manufacturing was implemented to the whole organization which involved all employees from top to down.

At the end of the study, the revelation of key success factors and implementation process of Lean Manufacturing of the studied company enable other companies to make it as a reference in future if they keen to implement lean in the future plan. Furthermore, the contribution of the lean assessment's results summarized the company current manufacturing system. This would enable them to see where is their current lean position and seek room for improvement.

VI. CONCLUSIONS

As a conclusion, this study is successfully completed as the objectives of the study are finally accomplished and achieved. Since Lean Manufacturing implementation had known as an unified system that enabled organization in various industries to eliminate wastes in all business processes for continuous improvement, study on key success factors and processes involved in initiating lean implementation is significant as a guideline for other company that interested to implement Lean Manufacturing in future.

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BIOGRAPHY

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