

Investigating the Impact of Lean Manufacturing Practices on Operational Performance

Nizam Hafiz Bandi¹, Ahmad Nazif Noor Kamar^{2*}, Cheng Jack Kie²

¹Faculty of Manufacturing and Mechatronic Engineering Technology, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia.

²Faculty of Industrial Management, Universiti Malaysia Pahang, 26300 Gambang, Kuantan, Pahang, Malaysia

ABSTRACT – In order to remain competitive and resilient in business, manufacturing companies must improve their operational performance continuously. Superior performance can no longer be achieved with abundance of time, resources, and money, but the right approaches and tools will allow companies to perform better with greater flexibility. As manufacturing companies try to identify the most beneficial approach, many conclude that Lean Manufacturing (LM) practices are the way to go. LM practices may seem promising at first, but its implementation doesn't always produce the desired results, and not all LM tools are universally applicable. Choosing the wrong tool might throw off the entire process though initially it meant to improve. Therefore, this study aims to determine the most used of LM tools and how these tools can impact the operational performance. A total of eleven completed responses were collected in the survey through convenience sampling method. Empirical results through descriptive analysis revealed that usage of LM tools such as 5S and Kaizen can lead companies in improving their processes. While lack of knowledge and resistance to change are the major barriers in practicing LM.

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INTRODUCTION

Manufacturing industry is the backbone of Malaysia's economy, and the markets in which manufacturing companies operate are highly competitive. It is no longer sufficient for companies to make better things by simply producing products that meet customer needs, but also must make things better by accelerating engineering technology, as well as improving their existing operations and management practices. A strong company would pave the way to increase their productivity and innovation capacity. In dealing with global market-driven demands, many companies have implemented LM tools to improve their operational performance [1][2], where continuous improvement, waste reduction, and sustainably deliver value to customer are practices that underlying the LM principles.

LM practices have been recognized as a process improvement approach that contributes positively to a company's competitiveness regardless of the type of industry in which it is implemented. Although LM practices are proved effective, implementation is not easy and gives no guaranties for success [3]. Companies need to find their own tactics to implement LM towards creating an encouraging environment that enables the achievement of the expected results. Implementation process requires proper planning of strategies and clear position to which extent the management want to be lean. Never try to deploy LM according management's belief and experience without performing proper study which can lead to misapplication [4].

Many LM tools are available for use but not necessarily all tools are suitable. Selection of LM tools is highly dependent on performance measures where inappropriate selection of tools can cause disruption in current operation. LM tools when used appropriately, can assist companies eliminate waste, improve quality, and obtain better overall operational control [5]. However, the actual impact of LM tools on operational performance measures, such as cost, speed, dependability, quality, and flexibility, is still unclear [6]. Furthermore, there is still an argument in literature about which tools are necessary and which are not to be considered lean. This divergence causes some confusion at the theoretical level, but it is more problematic at the practical level when companies aim to implement LM [7].

Motivated by the controversy in the literature and the need of research exploring this issue in the context of Malaysian manufacturing companies, this paper aims to investigate the impact of LM practices on operational performance. The term LM practices refer to the use of LM tools that support the concepts of continuous improvement and waste reduction which seek to achieve incremental changes in processes to improve operational efficiency. Since most companies have implemented LM in various forms and names according to their understanding, the findings of this paper offer company a better understanding of the importance of implementing LM practices and the barriers and, enable them to make better and wiser decisions about the selection of LM tools.

Lean Manufacturing

The LM practice has been implemented around the world to cope with challenges involved in managing a competitive manufacturing business. Despite having different definitions [8][9], the core principles that characterize LM have been defined similarly [10]. The concept originated by leading vehicle manufacturer in the early 1900s and was later adopted by other industries. Focus of this practice is the elimination of non-value-added activities or waste through continuous improvement by streamlining the processes. Waste refers to any activity that does not add value to the process for which the customer is not willing to pay. There are eight types of waste, namely waiting time, overproduction, extra processing, transportation, motion, inventory, defects, and non-utilized talent.

Lean has a very extensive collection of tools. Understanding what they are and how each tool can help to improve manufacturing operations, is a great way to get started. Some examples of LM tools are Value Stream Mapping, Kaizen, Kanban, Visual Management, 5S, etc. Usability of various LM tools needs to be explored before use because it depends on the situation and context. Manufacturing companies can successfully address some of their most significant problems if they use the right tool. Otherwise, it can ruin the improvement efforts and fail to achieve the expected results. Lean has been divided into three levels as shown in Figure 1 to summarize the practice for better understanding.

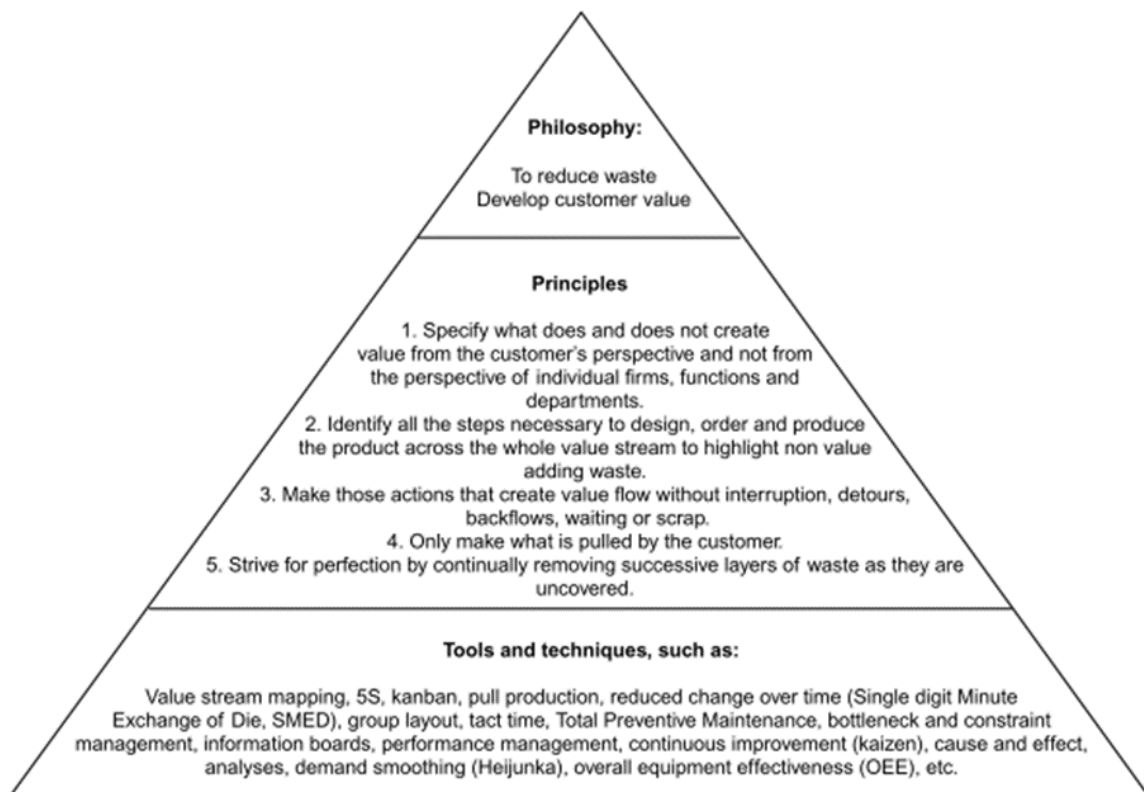


Figure 1. Lean in three levels [11]

A company that embarks on LM implementation makes a commitment to improve its operational performance and change the way it does its work for the benefit of those it serves. But not every company will succeed in the first attempt to make their operation and processes lean. Numerous causes of implementation failure have been outlined by researchers including lack of real understanding of LM concept [12], lack of implementation know-how [13], organizational culture that not well managed [14], and lack of approach related to the difficulties associated with change implementation [15]. Besides, simply replicating the change process of other companies' practices is unwise because culture, organizational pressures, and infrastructure support differ between companies.

METHODOLOGY

A total of eleven completed and usable questionnaires were received from respondents consisting of engineers and managers from manufacturing companies in Malaysia. The convenience sampling method was used where data obtained for this research did not have any additional requirements. The use of this method is also because it is impractical to test the entire population which is quite difficult to access. The time frame necessary for data collection was four weeks. The questionnaire used a nominal in section one, and ordinal scale in rest of the sections. Statistical package for social sciences (SPSS) and Microsoft excel computer program was used for statistical analysis, where the statistical data was analysed using descriptive analysis to describe and summarize the data points constructively.

Research Flow

The flow chart of the process for conducting this research is shown in Figure 2. It begins with the formulation of the research problem as well as the research objectives. The second step involved the creation of a survey questionnaire, and the selection of industries and companies for data collection purposes. The questionnaire was then transferred into Google form format and sent via email to the relevant companies. In the case of reliability test, Cronbach's alpha was used to measure the consistency of the research instrument or the questionnaire. The measure of reliability is an indication of the stability and consistency of the instrument.

The evaluated data will be able to show the impact of LM practices on operational performance, and at the same time, can determine which LM tools are frequently used by the respondents. Barriers to implementing LM practices and why companies fail to implement LM successfully are also investigated. The internal consistency of the LM practice elements and barriers was tested, where analysis was performed separately for the items of each element. The acceptable value of coefficient reliability is more than 0.70 with higher values symbolizing higher reliability among the indicators.

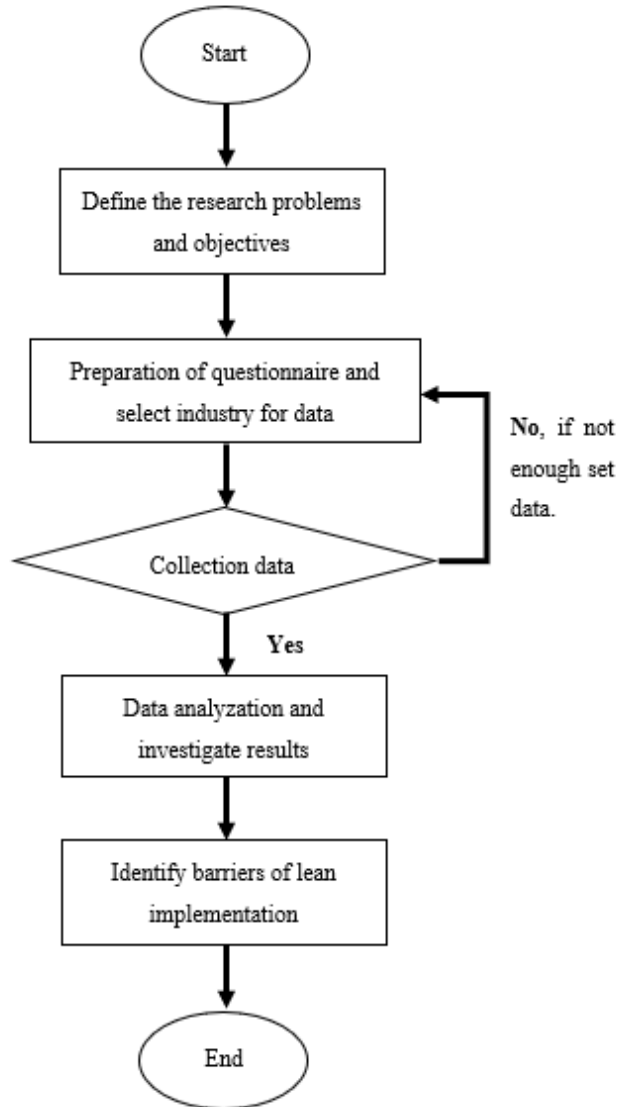


Figure 2. Research flow chart

Questionnaire

Data for this study was collected through a self-administered questionnaire survey, which means a survey that requires respondent to fill in answers to the questions presented. The list of questions was sent to respondent through the official email of the identified company. The company will determine the most suitable individual to complete the questionnaire sent. Questionnaire survey is effective only when the respondent has knowledge about the topic, and they are competent in answering the questions. The survey questionnaire is divided into three sections. First section is about company profile such as company ownership, number of employees, etc. The following section examines whether LM practices can benefit companies and the barriers. The final section deals with the use of LM tools in improving operational performance. Closed questions were used in this study which makes it easier for respondents to answer them in a shorter time.

RESULTS AND DISCUSSION

In first attempt of data collection, a survey questionnaire was sent by e-mail to 50 identified manufacturing companies. Unfortunately, 19 companies could not be contacted due to inactive e-mail addresses. After two weeks, there were only 4 responses out of 31 questionnaires that were successfully sent, and the rest were unanswered. The response rate achieved was only 8%, which is quite low. For this reason, alternative methods have been sought to increase the response rate. The survey questionnaire was then distributed via WhatsApp to the targeted contacts. Hence, 7 more responses were received after 2 weeks, which brings the response rate increase up to 22%.

Table 1 presents the descriptive analysis of demographic profile of respondents. A total of 63.6% of the respondents were engineer compared to 36.4% manager. Most respondents consisted of a group that had served less than 2 years in the company they worked for, a total of 54.5%. Nearly 64% of the respondents belong to the type of corporate ownership, and majority of them are familiar with LM practices. Companies with more than 100 employees represented the largest number of respondents, 72.7%, followed by companies with between 50 to 100 employees at 18.2% and companies with less than 50 employees at 9.1%.

Reliability testing was performed to investigate the reliability of the collected data. The total reliability scale for this study is 0.784, where all items in the questionnaire exceed the minimum Cronbach's alpha value of 0.70, and this shows that the research instrument used has high internal consistency and is believed to be reliable. While Figure 3 illustrates the result of the investigation of the effects of LM practices on operational performance. Frequency measurement with the Likert scale is used where the response to the given statement is measured with a value between 1 (strongly disagree) to 5 (strongly agree).

Table 1. Demographic profile of respondents

	Frequency	%
<i>Position in company</i>		
Engineer	7	63.6
Manager	4	36.4
<i>Years of service</i>		
< 2 years	6	54.5
2 to 5 years	3	27.3
> 5 years	2	18.2
<i>Ownership</i>		
Sole proprietorship	1	9.1
Corporation	7	63.6
Private Limited Company	1	9.1
Government Linked Company (GLC)	1	9.1
Multi-National Company (MNC)	1	9.1
<i>Number of employees</i>		
< 50 employees	8	72.7
50 to 100 employees	2	18.2
> 100 employees	1	9.1
<i>Familiar with LM practices</i>		
Yes	9	81.8
No	2	18.2

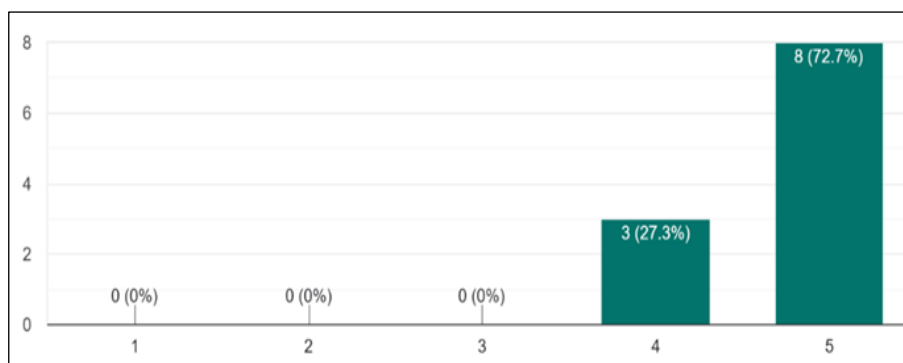


Figure 3. Impacts of LM practices on operational performance

Since all the respondents agreed that the implementation of LM can improve the company's operational performance, further analysis was conducted to find out the details. As shown in Figure 4, nine out of eleven respondents believe that by practicing LM, companies can improve their productivity. The second highest percentage based on selecting factor is better in managing change, followed by lead time reduction, having more efficient business processes, reduce costs, and others. In this section, analysis of results only reports the ranking and ordering of the data without establishing the degree of variation that exists between them.

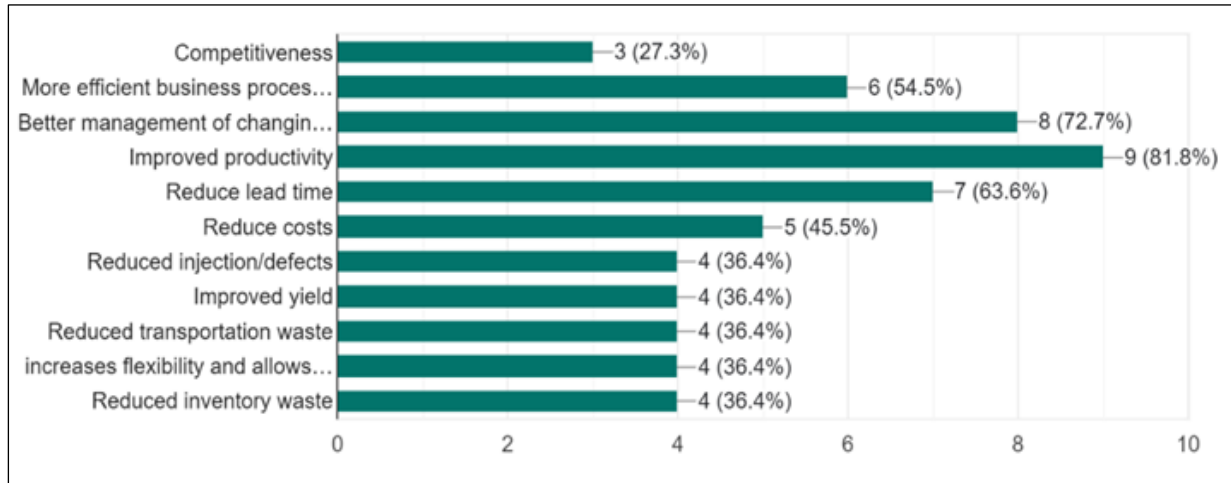


Figure 4. Factors that are categorized as operational performance

Process of implementing LM practices is not straightforward. It is essential to recognize and comprehend the variables that contribute to resistance and barriers before attempting to implement change in a company. If the management does not assess how prepared they are for change, they risk wasting significant amounts of time, resources, and money. Based on data collected, among the factors highlighted as obstacles in implementing LM are insufficient skills and knowledge of the workforce, employees resist to change due to not understanding the potential benefits of applying LM, inadequate management commitment to support, the absence of a strategy, and backsliding to the old inefficient ways of working.

Apart from implementation barriers, the use of LM tools for process improvement has also been explored. Each LM tool used plays a special role in achieving different objectives. Figure 5 demonstrates the tools used by selected companies in this study. About 91% of the participate respondents deployed 5S in their process. This tool is designed to reduce waste through maintaining an organized workplace and using visual cues to achieve more consistent operational results. Kaizen is in second place as the most used tool with a percentage of 72.7%, followed by poka-yoke with 45.5% and others. The advantages will compound as more tools are used, as they do support and reinforce each other.

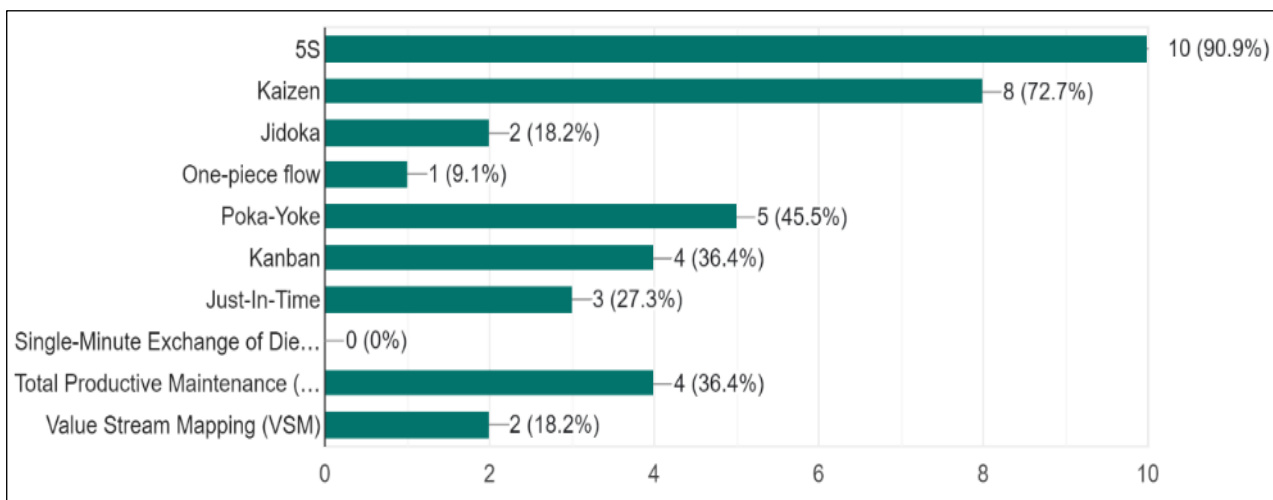


Figure 5. Lean tools that are utilized by companies

CONCLUSION

Implementation of LM practices is a process of applying a set of lean principles, tools, and techniques. Methods such as descriptive planning and conceptual model are commonly believed to be used to answer research question based on ‘what is’, while approaches like roadmap, implementation framework and assessment checklist usually answer questions on the basis of ‘how to’ [4]. Despite this, researchers still face difficulties in coming up with standard framework that suit all demands, and most of the proposed work do not discuss the implementation status in real environments [16]. Without solid knowledge of lean principles and tool usage, implementation attempts become tentative, confused, and tend to fail.

Manufacturing companies that successfully implement LM practices will be more competitive. By implementing LM, companies strive to restructure their management systems and improve performance of existing process while continuing to operate efficiently. LM tools are not a one size fits all, the usage requires proper planning and strategy. The management need to know in advance, what is involved and how the use of LM tools can affect operational performance. Changes or improvements in existing processes hold the key to increased productivity, and productivity gains are the key to economic growth. The reliable way to sustainable growth is through better processes which in turn result in superior performance.

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