



# Green Lean Practices towards Increasing Operation Value of Manufacturing Company

Ahmad Nur Aizat Ahmad<sup>1\*</sup>, Md Fauzi Ahmad<sup>1</sup>, Norhadilah Abdul Hamid<sup>1</sup>, Yunos Ngadiman<sup>1</sup>, Mohamed Ismail Pakir<sup>1</sup>, Gusman Nawanir<sup>2</sup>, Adnan Bakri<sup>3</sup>, Mustaqim Abdul Rahim<sup>4</sup>

<sup>1</sup> Department of Production and Operation, Faculty of Technology Management and Business Universiti Tun Hussein Onn Malaysia (UTHM), Parit Raja, Batu Pahat, Johor, MALAYSIA

<sup>2</sup> Faculty of Industrial Management, Universiti Malaysia Pahang, MALAYSIA

<sup>3</sup> Facilities Maintenance Engineering Department, Universiti Kuala Lumpur –Malaysian Institute of Industrial Technology, MALAYSIA

<sup>4</sup> Department of Civil Engineering, School of Environmental Engineering, Universiti Malaysia Perlis (UniMAP), MALAYSIA

\*Corresponding Author

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**Abstract:** Nowadays, manufacturing industries are rapidly developing. However the constraints faced by today's producers are how to produce their products quickly through low costs while at the same time, the reduction of waste disposal in the environment. The high waste of time in the manufacturing industry is often attributed to the wastage that occurred in the company's operations. Lean manufacturing is linked for improving the standard working. It is one of the production strategies that drive the industry towards a more efficient production of goods and services. Meanwhile, green manufacturing has been adopted as a requirement to achieve a minimal negative impact on the environment. The green lean is a concept to make sure system more efficient, reduce unwanted product releases and minimize the environmental impact. So, the main objective of this research is to reduce cycle time in manufacturing company by adopting green lean elements. This research focuses on furniture manufacturing and conducted a structural interview question, observation and time study method. To refine those time operation problems, the company had implemented the new green lean practices into the operation department. The results after implement these methods totally show an improved progress. The paper would help the manufacturer to organize and improve their company performance. In conclusion, this research is about to identify and reduce the time waste to improve the operation value of the manufacturing company while at the same time it would reduce the environmental impact in future.

**Keywords:** Lean manufacturing, green manufacturing and green-lean

## 1. Introduction

The national development economy is increasingly aggressive in the competition to form an urbanized nation. The manufacturing sector is one of the most active sectors to implement the country's development mission. Nevertheless,

Malaysia are in the wake of the country's economic development which is something that Malaysia need to realize and care about environment of earth that is now in crisis. So, to overcome that situation the green lean tools implementation is especially important in every company because it wants to prevent and control in good environment while their productivity still maintain in rise. Mostly, the problems occurred are related to the time of operation. According to [1], one of the improvements to be done is reduce operation time which did not added value for the company. Most manufacturers are not exposed to the existence of lean which is the reason why the company not applying the lean system. According to [2], blaming the people who lacking understanding of the relationships between the lean and green manufacturing concepts as a result of poor implementation of lean. Although green lean are recognized as important, they are still perceived as costly and unrelated to process improvement in the majority of companies as mentioned by [3]. This research consists of 2 main objectives which are, i) To reduce cycle time of manufacturing company by adopting green lean elements to improve operation value and ii) To analyze the outcomes of adoption green lean at the manufacturing company. These objectives is the main issues to be implemented in manufacturing company. This study is important as it helps the researcher and the manufacturers to make any references and gain knowledge. This study identified the lean elements that have been used by company in their production line. This study purposed green lean to improve current operation time. It is important for manufacturing company to support green lean element for analyzing the impact of the green lean. Furthermore, the others manufacturer also can improve their quality of productivity by implementing green lean towards their operation.

## **2. Literature Review**

This section presents a review of the literature on lean manufacturing, green manufacturing, green lean, and waste. It also highlights the tools of lean and discusses the gap between lean and green manufacturing and others.

### **2.1 Lean Manufacturing**

Lean manufacturing (LM) relies on certain principles such as standardized processes, levelled production, JIT practices, visual inspection, and continuous improvement. According to [4], lean manufacturing is a system that focuses on the elimination of all types of waste in the production system to increase production time and product quality. Thus, LM facilitates manufacturing companies through better resource utilization, reducing human effort and timely delivery to customers in a more competitive manner. LM tries to reduce waste and simplify industrial processes, including within its strategies the minimization of the complexity that could be generated by the use of information technologies.

### **2.2 Green Manufacturing**

Green manufacturing (GM) is the process of designing, manufacturing, delivering, and disposing of products that can have minimal negative impact on the environment and society and are economical. According to Miller et al., (2008), this green concept is a socially responsible social status company. There are seven types of waste that can be identified with green as lean, excessive use of water, excessive use of power, excessive use of resources, pollution, waste, greenhouse effect and eutrophication. However, there are also writers who have defined the eighth type of waste which is poor health and safety as mentioned by [5].

### **2.3 Green Lean**

The use of green lean is derived from a combination of both terms. Based on lean and green, their inequality seems to be a focus on waste reduction. However, according to [6], it can state the green lean search for a more efficient system to reduce unwanted product releases, and the environmental impact of their concepts along the supply chain and internal operations of an organization. According to [7], the process improvement over operating and operating cost reduction is one of the functions for lean green. This green lean can be inferred as an effective tool for improving processes and costs.

#### **2.3.1 Benefits of Green Lean**

The implementation of green lean brings up a few of advantages to the industry such as are:

- i. Fewer defective products
- ii. Less overproduction
- iii. Limiting transportation.
- iv. Reducing excess inventory
- v. Reducing over processing

## 2.4 Waste

The meaning of waste based on the lean philosophy by [5], it is defined as any process activity that does not contribute or raise value to a product transformation to its final form as sold to the customer. Waste is also a substance that is released into the environment and it will cause a change that can bring harm to it. There are three main types of waste:

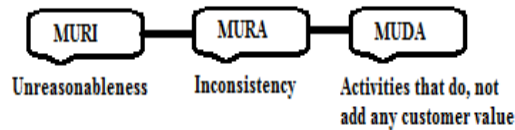


Fig. 1 - Type of Waste

According to Figure 1, aside from “Muda” or waste, the lean system also attacks and avoids the “Mura” and “Muri”. These three terms will cause inefficiencies and high costs in any operations. Waste (Muda) is an essential part because waste can increase costs even it cannot add value for the customer. The waste can list by several terms which are: overproduction, waiting, transport, inventory, over-processing, motion, and defects.

## 2.5 Tools of Lean

There are many types of lean tools to minimum waste and continuous improvement of all activity and process of work are the basic of purpose in lean manufacturing.

### 2.5.1 Just in Time (JIT)

Just in time (JIT) is about a timing of production flow at manufacturing line which is it must use in immediately time; all of needs at production process must in time. Just in time is an element which they need the raw materials at that time without less a minute. So, it is needed to reduce or remove waste in overproduction, waiting late delivery and excess inventory to achieve operation time efficiently.

### 2.5.2 5S

5S is a tool that focuses on things that are useless and unnecessary during operations at work. Furthermore, it aims to create a strategic means of storage for the use, search made and resettlement to the origin of the goods.

### 2.5.3 Kanban

Kanban is about a way to communicate between processes that help to establish ‘pull system’. Kanban according to [8], a manual system used to control the movement of parts and materials that respond to signals to be sent to the next workstation. Furthermore, this Kanban system also is a system of control over the inventory of stocks of products that have been produced for customer needs and demands.

### 2.5.4 Kaizen

Kaizen's model is an effort to improve the process into a more meaningful way. The priority in this Kaizen model is to always make small improvements in a process and workplace standard. Kaizen is a process, which is not a one-time adjustment to being able to make that work look better. But it must be part of the daily routine of the worker. Kaizen should also be part of the company's culture so employees and employers are always in the forefront of looking for solutions to improve workflows. This is the essence of Kaizen and it becomes its greatest strength as mentioned by [9].

## 3. Research Methodology

Research methodology is a method of collecting data and analysing information for decision and eventually procedures a conclusion as been described by [10]. Generally, data is collected and divided into two categories, primary data and secondary data. While conducting this research, there are few methods been used such as time study technique, data collection and analysis of current and future situation. All methodology been done in the early phase of the research.

### 3.1.1 Interviews

Based on [11], interviews are a two-way concept that aims to gather study information. For this study, the interview was conducted verbally. Through this method, various perceptions and advice are obtained from employees at the studied Company.

### 3.1.2 Observations

The role of the researcher is as an observer of behavioural changes, listening, as well as seeing the behaviour of the subject either from afar or near. Observations are made with the help of tools such as camera and stop watch by smartphone.

### 3.1.3 Data Collection

While conducting this research, there are few steps been accomplished. Below are the data collection strategies:

- i) Studied the flow of manufacturing process in detail.
- ii) Identified wastes that should be removed.
- iii) Decided of whether the process can be arranged in more effective and efficient sequence.
- iv) Discussed of a better flow pattern, involving different flow layout or transports routing.
- v) Discussed of whether everything that is being done at each stage is really necessary and identified what would happen if extra task were removed.

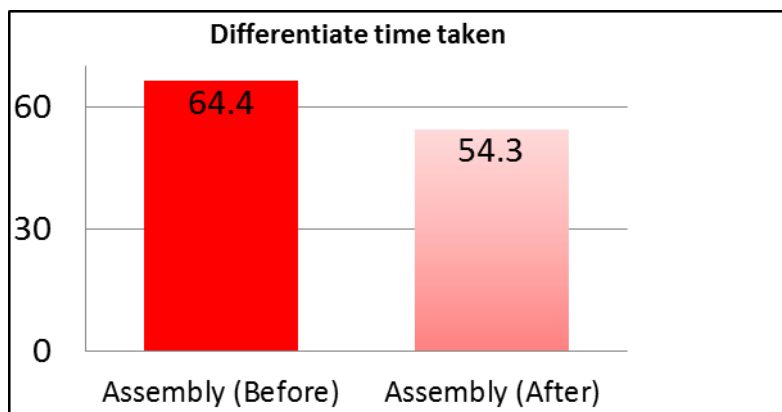
## 4. Results

Based on the improvements been done in this research, actual the operation time have been reduced. Table 1 shows the result before and after green lean been implemented.

**Table 1 - Outcomes of green lean implemented**

Comparison of Results	Before Green Lean	After Green Lean
	Practice	Practice
Total cycle time	238.8 Min	214.5 Min
Reduction time	0 Min	-24.5 Min
Percentage reduction	0%	10.16%
Process / Station	8	7 (12.5%)

This operation process reduced by using exchange the tools, job enrichment, repair the manufacturing method and remove the non-value process. Its shows 10.16% improve from existing time and 1 process been reduced to produce same item and quality of the product. Time to produce the items been reduced from 238.8 minutes to 214.5 minutes, around 24.5 minutes.



**Fig. 2 - Comparison time for assembly process**

Figure 2 proves that there are reductions time in the assembly process. The reduction is around 10 minutes after green lean been implemented to the assembly process. Although the reduction only around 10 minutes, the smaller number of minutes can give the big impact for manufacturing company. The number reduced from 64.4 minutes to 54.3 minutes.

Based of result on Figure 3, the operation time after green lean practise is better than before. Cycle time been reduced to 214.5 minutes and almost 25 minutes or around 10.89% better per cycle. It shows the efficient of green lean practise in this company.

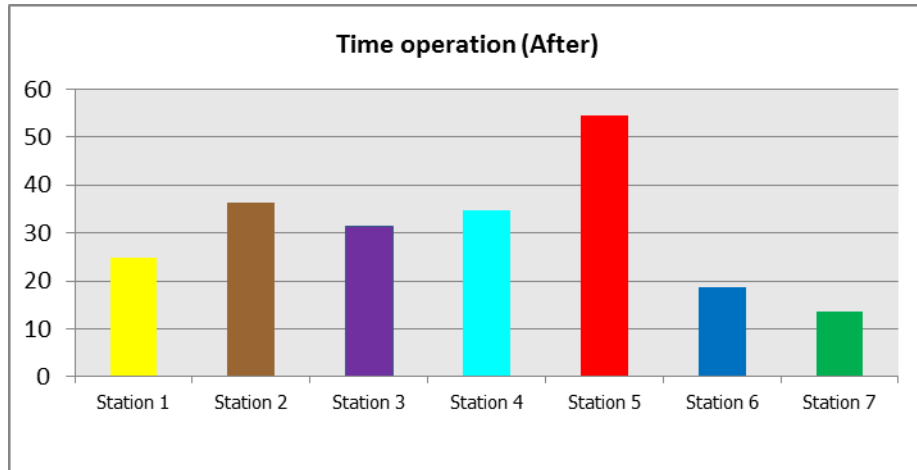


Fig. 3 - Comparison of result for operation time (after)

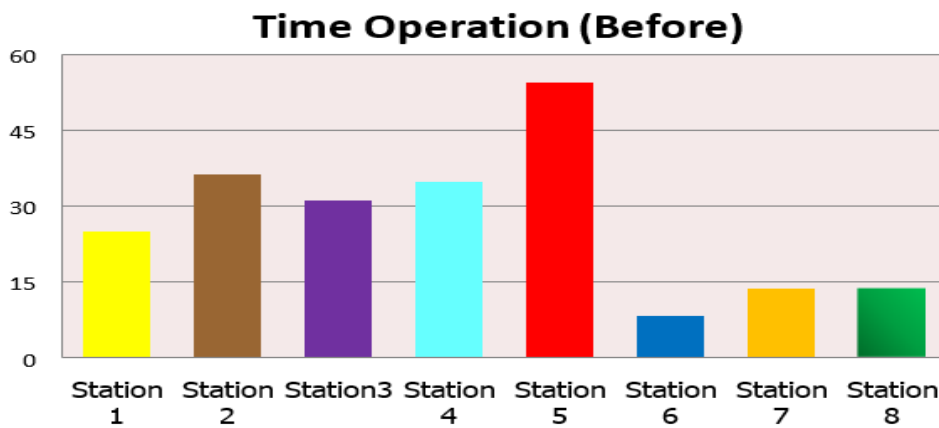


Fig. 4 - Operation time (before)

Figure 4 shows time operation taken before green lean been implemented in the studied company. This process consists of 8 processes, and after green lean been implemented, number of process been reduced to only 7 processes.

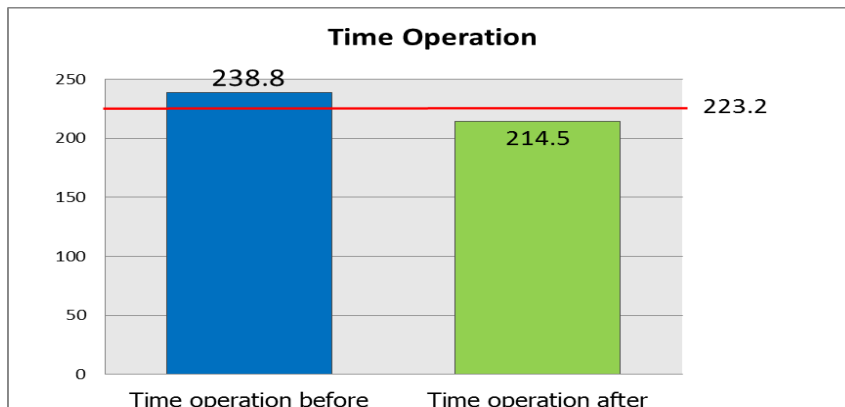


Fig. 5 - Operation time

Lastly, Figure 5 shows the operation time before is 223.8 minutes and the operation after is 214.5 minutes. Time operation showing that the company doing wastage of time while producing output. It will affected to fulfil the demand from customer. While implementing this green lean, the operation time showed a downward drop of the takt time to 8.7 minutes. From the results shown, it is proven that green lean helped the company to reduce its operation time while producing output. And at the same time, reduce all the related wastes been mentioned before.

## 5. Conclusion

The objectives of this research were achieved through the observations time study at the particular company. There are also several of suggestions and recommendations have been come out as a guide and references for other researchers. This study has been successfully implemented and succeeded in achieving all its objectives. But, after getting the information sharing from the company and the results of this research, it is clear that the manufacturing industry in Malaysia is still in the limited knowledge of green lean tools.

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## References

- [1] Embong, H. (2013). Simulation Modeling and Analysis of Productivity Software, (June).
- [2] Johansson, G., & Winroth, M. (2009). Lean vs. Green manufacturing: Similarities and differences. Conference: 16th International Annual EurOMA Conference, (JUNE), 1–10.
- [3] Digalwar, A. K., Tagalpallewar, A. R., & Sunnapwar, V. K. (2013). Green manufacturing performance measures: An empirical investigation from Indian manufacturing industries. *Measuring Business Excellence*. <https://doi.org/10.1108/MBE-09-2012-0046>
- [4] Gandhi, N. S., Thanki, S. J., & Thakkar, J. J. (2017). Ranking of drivers for integrated lean-green manufacturing for Indian manufacturing SMEs, 171(October 2017), 675–689. <https://doi.org/10.1016/j.jclepro.2017.10.041>
- [5] Uhrin, Á., Bruque-Cámara, S., & Moyano-Fuentes, J. (2017). Lean production, workforce development and operational performance. *Management Decision*, 55(1), 103–118. <https://doi.org/10.1108/MD-05-2016-0281>
- [6] Mollenkopf, D., Stolze, H., Tate, W. L., & Ueltschy, M. (2010). Green, lean, and global supply chains. *International Journal of Physical Distribution & Logistics Management*, 40(1/2), 14–41. <https://doi.org/10.1108/09600031011018028>
- [7] Duarte, S., & Cruz-Machado, V. (2013). Modelling lean and green: a review from business models. *International Journal of Lean Six Sigma*, 4(3), 228–250. <https://doi.org/10.1108/IJLSS-05-2013-0030>
- [8] Desta, A., Asgedom, H. B., Gebresas, A., & Asheber, M. (2014). Analysis of Kaizen Implementation in Northern Ethiopia's Manufacturing Industries. *International Journal of Business and Commerce*.
- [9] Ravindra, B. N., & Pranay, A. M. (2016). Kaizen Concept, 467–482. Retrieved from <http://data.conferenceworld.in/ICRISMET/P467-482.pdf>
- [10] Galeazzo, A., Furlan, A., & Vinelli, A. (2014). Lean and green in action: Interdependencies and performance of pollution prevention projects. *Journal of Cleaner Production*. <https://doi.org/10.1016/j.jclepro.2013.10.015>
- [11] Chua Yan Piaw. (2006). *Asas Statistik Penyelidikan - Buku 2*. Mc Graw Hill Education. [https://doi.org/10.1016/S1470-2045\(09\)70076-2](https://doi.org/10.1016/S1470-2045(09)70076-2)