

AN INVESTIGATION INTO LEAN PRACTICES AND THEIR IMPACT ON SUSTAINABILITY PERFORMANCE IN THE LATEX GLOVE MANUFACTURING INDUSTRY

S.Tanushan¹ and N.M. Razali¹

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

ABSTRACT – Lean is characterized as a collection of management practices. Lean's central philosophy is to minimize and eradicate non-value-adding practices and waste. High quality and customer loyalty are guaranteed by the Lean process. Lean concept obtains its root from Toyota Production system (TPS). The TPS approach is often well suited to high-volume manufacturing. Lean, however, is also applicable in any setting where process waste is encountered. The intent of this study is to develop a lean sustainability performance assessment to analyze the level of lean implementation and its impacts on sustainability performance in Latex Glove Manufacturing Industries. The assessment method is generally in the form of Five-Point Likert Scale Questionnaire which consists of two main sections, Section A, to determine the level of lean practices in the company and Section B to distinguish the impact of the implemented lean practices on sustainability performance in the aspect of social, environmental and economic. Thirty employees from three different Latex Glove Manufacturing Industries (Company A, B, and C) in Selangor were involved in this study. The data was then analyzed using Minitab 15. Among the 22 combined hard and soft lean tools, Just-In-Time (JIT) for hard lean tool and Customer focus for the soft lean tool has scored the highest level of implementation in all three Industries. As for sustainability performance, economic sustainability performance scored the highest average mean score followed by environment and social sustainability performance. Overall, the finding shows that Company A and C have an overall better impact towards sustainability performance by the execution of lean practices as compared to company B. This must be predominantly due to the high level of implementation of soft lean tools as both the companies have a high level of implementation for the majority of the soft lean tools as compared to the implementation of hard lean tools. In conclusion, the higher the level of implementation of lean tools and practices, the greater the impact on it the sustainability performance in a company.

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INTRODUCTION

In order to improve productivity and effectiveness by reducing waste, Lean practices have been widely applied in the manufacturing industry. Lean's central philosophy is to minimize and eradicate non-value-adding practices and waste. High quality and customer loyalty are guaranteed by the Lean process. Lean concept fundamentally inspired from Toyota Production System (TPS). Lean, however, is also applicable in any setting where process waste is encountered [1]. There are many advantages associated with lean manufacturing, such as reducing production cycle time, improving delivery time for goods or services, minimizing or eliminating the possibility of generating defects, lowering inventory levels, leveraging capital for key improvements among others, and many more [2].

Sustainable production refers to the creation of produce items that use methods that have a minimal environmental effect, preserve energy and natural resources, are safe for employees, communities, and customers, and are commercially viable [3]. More recently, environmental and social problems, as well as economic concerns, have become increasingly important issues within our communities and economies. Even some authors [4] claim that lean manufacturing appears to have a considerable influence on mitigating environmental impacts such as air, water, and soil emissions, as well as water and energy consumption efficiency. Indeed, there are also benefits associated with environmental management whenever a Lean tool is used. Manufacturing sectors employ a significant amount of energy and generate a significant quantity of wastes globally [5]. With increasing customer demand for firms to be economically, socially, and fiscally responsible, organizations have grown more conscious of the strategic position of long-term performance for competitive advantage [6]. The performance of lean sustainability, however, is still vague today because some organization simply applies the principle of lean manufacturing without assessing the performance of the lean sustainability. Thus, in this study, the lean sustainability performance of Latex Glove Manufacturing Industries will be assessed. According to [7], numerous studies that explored the link between lean manufacturing and sustainability efficiency seemed to have two drawbacks. To begin with, the impact of lean manufacturing on organisations' sustainable output focuses solely on the

environmental, social, and economic elements of sustainability, rather than all three at the same time. Second, most past research has only assessed the overall impact of lean manufacturing on firm performance. A study by [8] noted that environmental, economic and social output should be balanced in order for a manufacturing company to compete in the current competitive market. Therefore this research study aims to investigate the lean practices and its impact towards sustainability performance in all the three aspects, environmental, social and economic in Latex Glove Manufacturing industries in Malaysia. Moreover, there are many researchers on the lean theory and its impact towards sustainability in manufacturing industries in Malaysia and most of it seems to be only focus on Automobile industries [9], Electronics industries [10] and Food and Beverage industries [11], but when it comes to Glove Manufacturing industry there are almost zero studies neither on the implementation of lean manufacturing or sustainability performance. Hence, this study will certainly aid the rest of the Glove manufacturers to understand and obtain the full lean benefits in their respective organizations.

OVERVIEW OF SUSTAINABILITY PERFORMANCE

The sustainability concept has been contemplated in many fields including engineering, sciences and particularly in business and management [12]. There are three major pillars of sustainability metrics which are social, economic and environmental [13]. These metrics are selected to be the triple bottom line. Triple bottom line concept is exceptionally well-known which pillars on the social, economic and environmental performance. The concept of the triple bottom line is always be the way to represent the sustainability of the firms. This approach highlighted the three-dimensional nature of sustainable development of economic growth, environmental stewardship, and social well-being. Lean manufacturing practices are theoretically connected with the strength in various components of competitive performance simultaneously. **Figure 1** shows the triple bottom line approach towards sustainability which consists of environmental, social, and economic. A sand cone model approach of sustainability performance had been proposed Henao et al. which economic performance at the base of the model and is driven by lean manufacturing implementation as seen in **Figure 2**. The literature on the interrelationship between lean and sustainability has been studied extensively by [14].

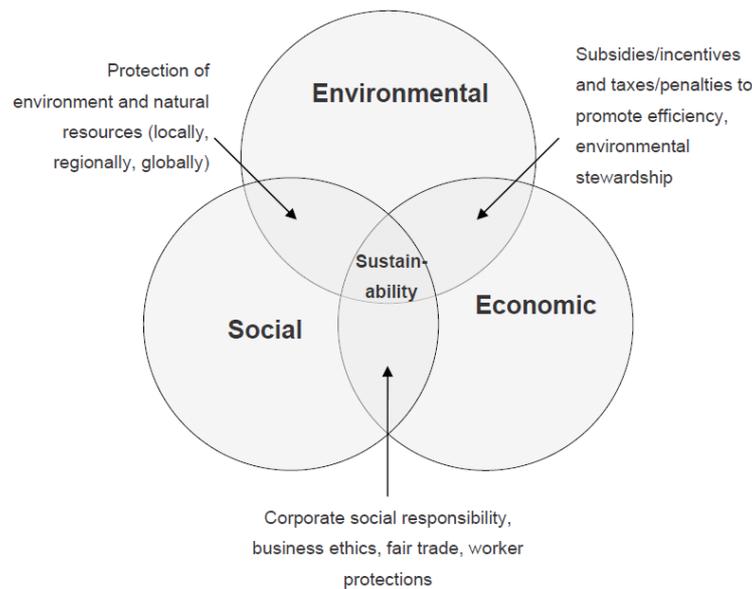


Figure 1: The Triple Bottom Line Approach [15]

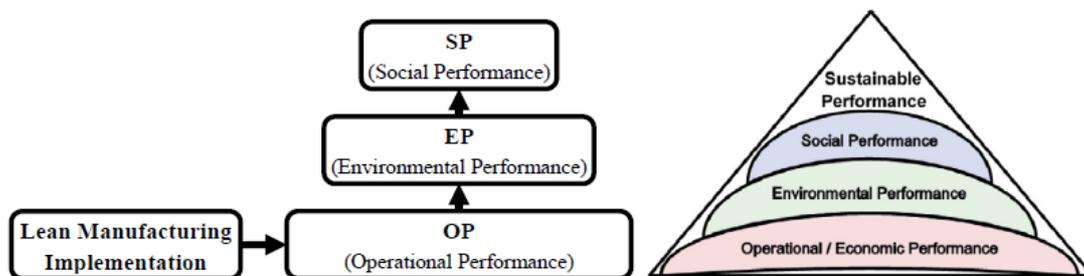


Figure 2: Sustainable Performance in Sand-Cone Model [16]

METHODOLOGY

A structured questionnaire was used to collect data in this study in order to investigate the lean sustainability performance of the companies. A lean sustainability performance assessment was created in the form of a Five-point Likert Scale type questionnaire so that the scale created can be easily measured and analyzed using statistical analysis. The questionnaire is divided into 2 sections, Section A (Identification of Level of Lean Practices Implemented in the Company) and Section B (Evaluation of Sustainability Performance in the aspect of Social, Environment, and Economic based on the Implemented Lean Practices). The lean sustainability performance assessment will be verified by academicians and industry personnel before the questionnaires being distributed to the selected Latex Glove Manufacturing Industries.

In Section A, the respondents were asked to rate between (1) Not implement, (2) Low level of implementation, (3) Intermediate level of implementation, (4) High level of implementation, and (5) Advanced level of implementation. Similarly, for Section B, respondents were asked to rate between (1) Strongly disagree, (2) Disagree, (3) Neutral, (4) Agree, and (5) Strongly agree for the evaluation of the sustainability performance in the company.

The collected data is analyzed using Minitab 15 to determine the level of lean implementation in each company and also its impact on the sustainability performance of the respective companies.

RESULT AND DISCUSSION

VALIDATION OF THE SUSTAINABILITY ASSESSMENT

The verification of the lean sustainability performance assessment is done by 3 academicians and 3 industry personnel with strong lean and sustainability knowledge. The questionnaire is validated by sending the survey questionnaire to those experts personally via email and asking them whether they agree or disagree with the constructed lean sustainability assessment questionnaire. **Table 1** shows the percentage (%) of academicians and industry personnel who agree and disagree with the developed survey questionnaire.

Table 1: Validation Percentage (%) of Survey Questionnaire

Experts	Percentage (%)	
	Agree	Disagree
Academicians	100	0
Industry Personnel	100	0

Based on **Table 1**, both the experts have agreed with the developed survey questionnaire which means that the questionnaire is now validated and it is allowed to be distributed to Latex Glove Manufacturing industries in order to assess the impact of lean practices on the sustainability performance in the respective industries.

Test for Internal Consistency

In this section, the internal consistency of the Likert scale for both Section A (Level of Implementation of Lean Tools and Practices) and Section B (Sustainability Performance resulting from the Implemented Lean Practices) for all the three companies will be measured by using Cronbach's alpha. A Cronbach's alpha value which is greater than or equal to 0.7 is preferred as it indicates acceptable internal consistency and any value less than that indicates the data has poor reliability [17]. **Table 2** below shows the Cronbach's alpha for Section A and Section B.

Table 2: Cronbach's Alpha for Section A and B

Section A (Level of implementation of Lean Tools and Practices)	Cronbach's Alpha
Lean Tools and Practices	0.9452
Section B (Sustainability Performance)	Cronbach's Alpha
Social Sustainability Performance	0.8149
Environment Sustainability Performance	0.9334
Economic / Operational Sustainability Performance	0.9008

From **Table 2**, the Cronbach's alpha for both level of implementation of lean tools and sustainability performance shows that the score is reliable, and the items are closely related as a group since the score for the both sections are greater than 0.7.

Level of Implementation of Lean tools and Practices

Figure 3 shows that Company C has the highest mean score which is 4.289 followed by Company A (4.041) and Company B (3.494). This shows that Company A & C have a high level of lean implementation and Company B has an intermediate level of lean implementation.

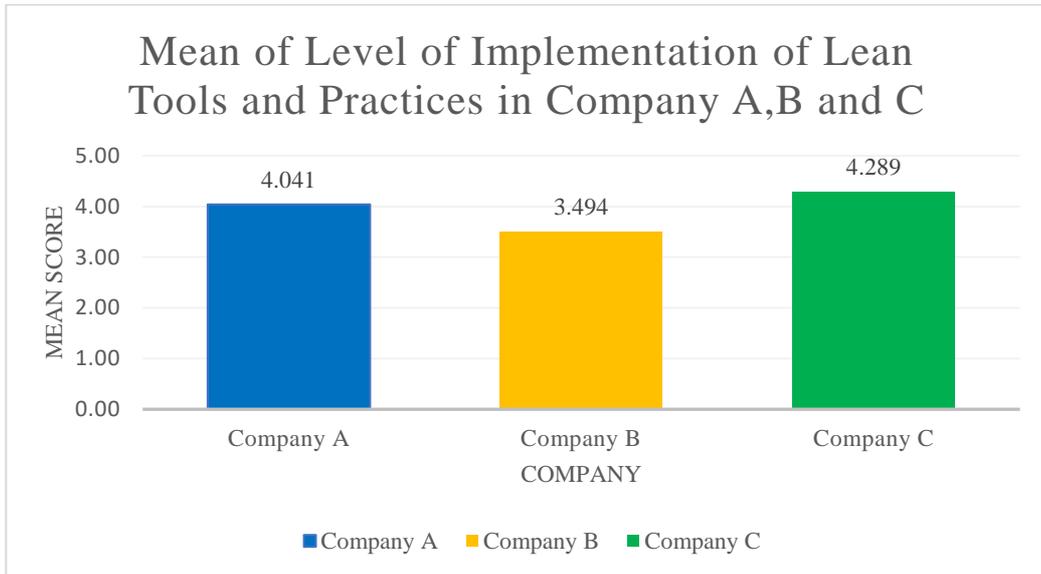


Figure 3: Mean of Level of implementation of Lean Tools & Practices for Company A, B & C

Comparison of Level of Implementation of Lean Tools between Company A and Company C

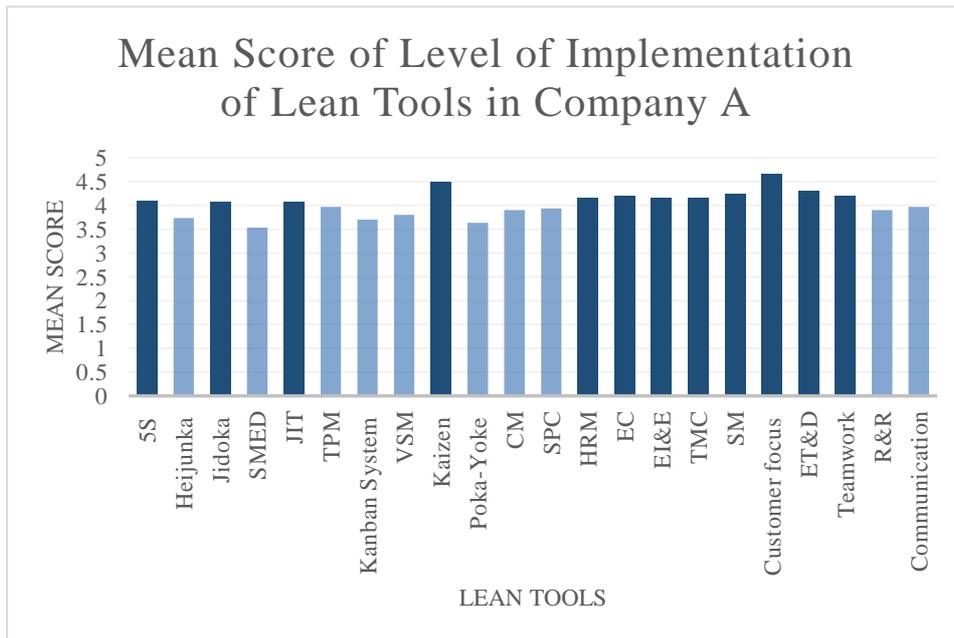


Figure 4: The Mean Score of Level of Implementation of Lean Tools for Company A

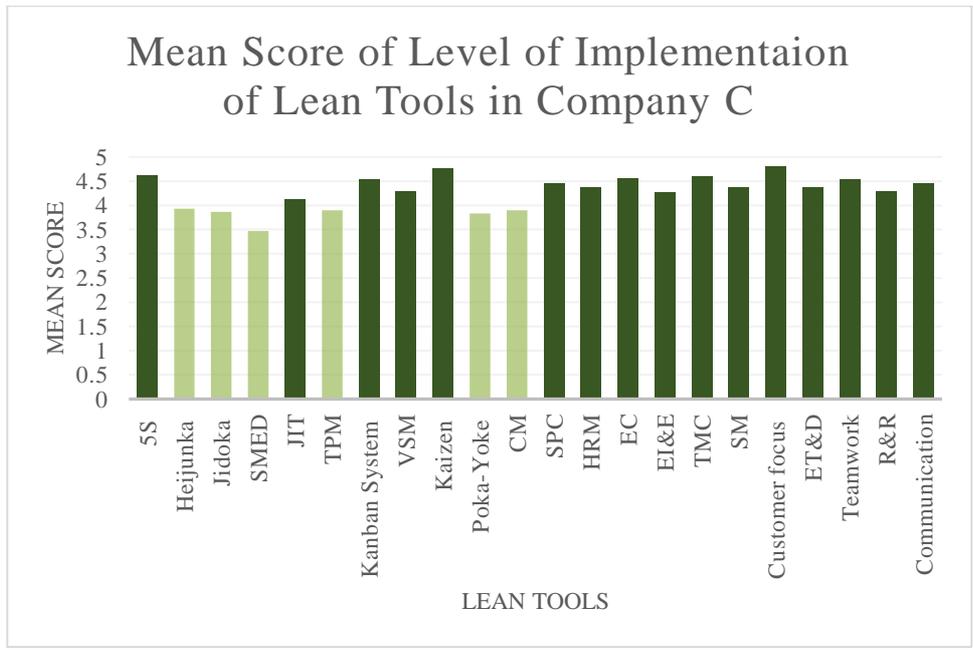


Figure 5: The Mean Score of Level of Implementation of Lean Tools on Company C

Based on **Figure 4** and **Figure 5**, the dark-colored bar represents lean tools that have a high level of implementation which is more than a scale of 4. The highest level of implementation of a lean tool for both companies is Customer focus with a mean score of 4.667 for Company A and 4.800 for Company C and SMED are the lowest implemented lean tool in the companies with mean scores of 3.533 and 3.467 for Company A and Company C respectively. As for hard lean tools, 5S, Jidoka, JIT, and Kaizen seem to be a high level of implementation in Company A whereas for Company C the highly implemented hard lean tools are 5S, JIT, Kanban system, VSM, Kaizen, and SPC. 5S, JIT, and Kaizen are among the lean tools that are commonly being implemented at a high level in both companies. As for the soft lean tool, 80% of the soft lean tools listed are being applied at a high level in Company A except for Reward and Recognition (R&R), whereas Communication is in the intermediate level of implementation. On the other hand, Company C seem to be really engaged in the soft lean tools, as all the soft lean tools listed have a high level of implementation in the company.

Sustainability Performance resulting from Implemented lean Practices

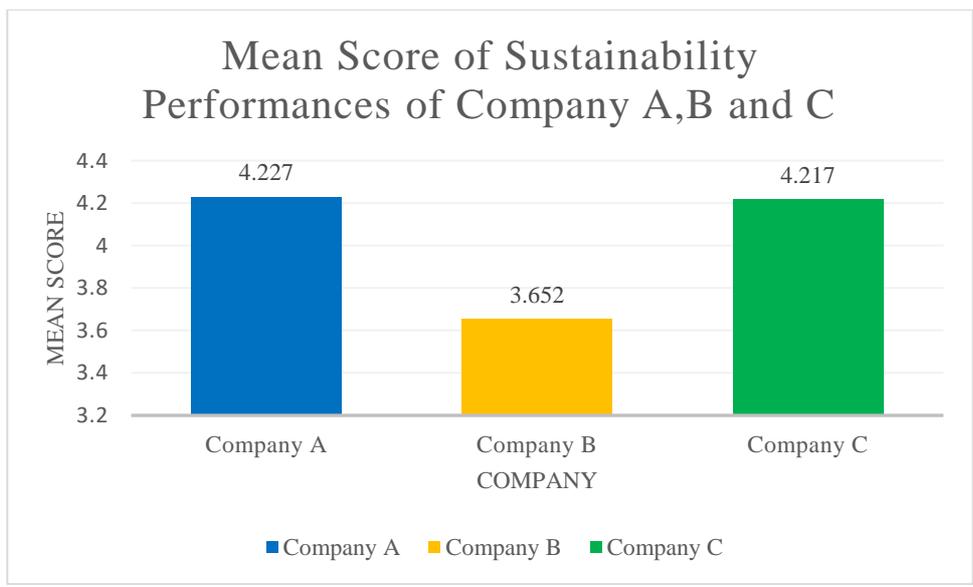


Figure 6: Mean Score of Sustainability Performance of Company A, B & C.

Table 3: Comparison on Sustainability Performance based on Companies

Sustainability Performance	Mean			Average Mean
	Company A	Company B	Company C	
Social	4.060	3.300	3.967	3.776
Environment	4.183	3.533	4.206	3.974
Economic/Operational	4.439	4.122	4.478	4.346
Average Mean	4.227	3.652	4.217	

From **Figure 6**, Company A has the highest average mean score for sustainability performance (4.227), followed by Company C (4.217) and Company B (3.652). **Table 3** displays that all the three companies seem to be having more benefits in terms of economic sustainability performance by utilizing lean tools as it has the highest average mean score (4.346) compared to social and environmental sustainability performance with scores of 3.776 and 3.974 respectively.

Relationship between Level of Implementation of Lean Practices and Sustainability Performance

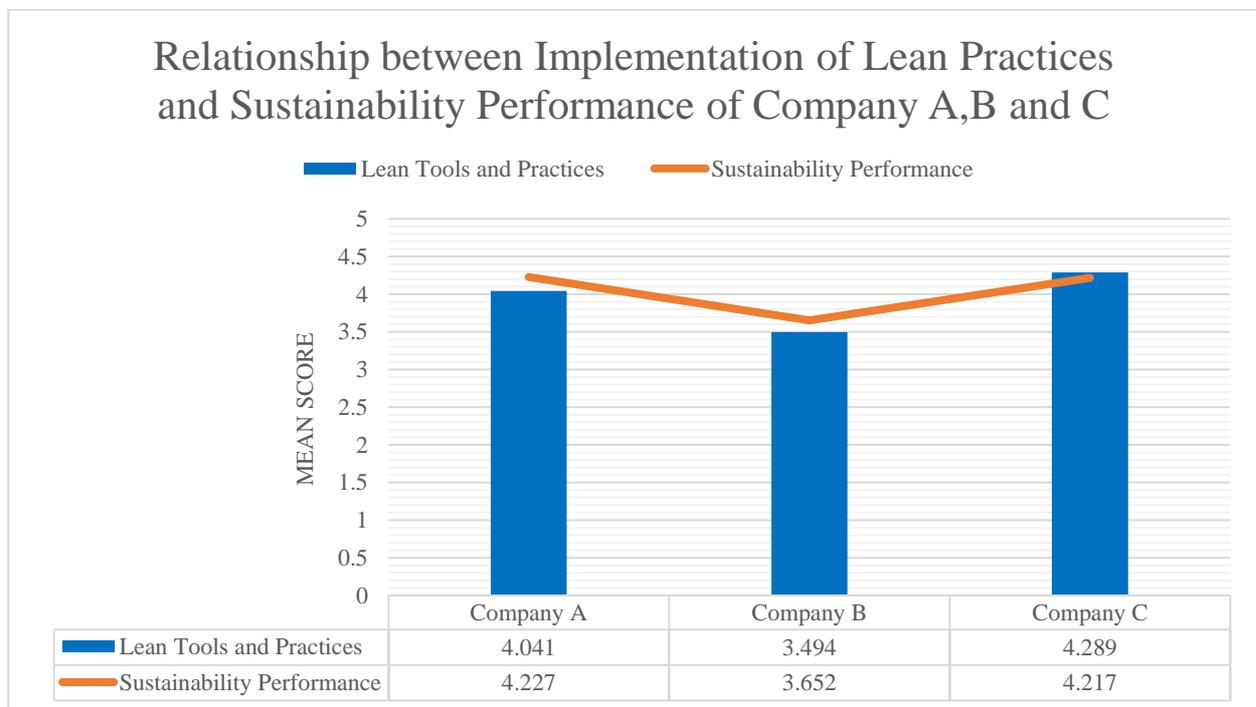


Figure 7: Relationship between Level of Implementation of Lean Practices and Sustainability Performance of Company A, B, & C

Based on **Figure 7**, it can be said that the higher the level of implementation of lean tools and practices, the higher the positive impact of it on the sustainability performance. In this case, Company A and Company C scored more than 4.0 for both implementation and their performance level compared to Company B which scored less than 4.0 for its implementation and performance level. Thus, the lean tools and practice must be utilized at a higher level in a company in order to get full benefits of it in terms of sustainability performance.

CONCLUSION

A lean sustainability performance evaluation for Latex Glove Industries in the form of a Likert Scale Questionnaire was successfully developed and verified by academicians and industry personnel. The degree of application of lean tools and practices, as well as their impact on sustainable performance, are then assessed using the developed survey method. From the result of the analysis, Company A and C have a high level of implementation of lean tools and high sustainability performance score as compared to Company B. The major impact towards the high sustainability performance score of Company A and Company C must have come from the implementation of soft lean tools as the majority of the soft lean tools ($\geq 80\%$) listed have a high level of implementation in both of the companies as compared to the implementation of hard lean tools with only $\leq 50\%$ of the high level of implementation in the companies.

Overall, it can be concluded that the companies benefit more from economic sustainability performance as compared to social and environmental sustainability performance through lean implementation. These three latex glove manufacturing industries might have been more focusing on the development of economic sustainability through the implementation of lean tools as it directly affects the productivity and production cost which will eventually boost the company's overall profitability.

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