



Lean Principles in Small-Medium Enterprises in Malaysia: Creating A Web-Based Training

Zarirah Karrim Wani¹, Yap Woan Wei¹, Hasnida Ab Samat^{1*}, Ahmad Baharuddin Abdullah¹

¹School of Mechanical Engineering, Engineering Campus,
 Universiti Sains Malaysia, 14300 Nibong Tebal, Pulau Pinang, MALAYSIA

*Corresponding Author

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Abstract: Lean principles (LP) are well-established strategies for increasing the throughput of business organizations. Many large corporations have benefited from LP implementations in their organizations. However, acceptance of LP implementations among Small and Medium Enterprises (SMEs) remained low, owing primarily to persistent prejudice and a lack of access to LP tools. This paper presents a Web-based Training (WBT) approach to alleviate such constraints and to accommodate the circumstances of SMEs in term of their financial, time and knowledge resources. The fundamental concepts of LP, SME, and WBT are presented in the first part of this paper based on a review of literature studies. Following that, the development of optimal WBT modules is elaborated on the basis of survey validations on the connectivity of LP and SMEs in Malaysia, emphasizing the use of simple words and terms for ease of comprehension by the targeted SME users.

Keywords: Lean manufacturing, lean principles, concept studies, small and medium enterprises, web-based training

1. Introduction

Nowadays, industries must understand lean manufacturing and processes in order to improve their bottom line. Successful LP implementations have been shown to benefit organizations both directly and indirectly. It is regarded as an important tool for all types of organizations in order to improve the company's operations [1], reduce costs, and improve the use of which can be subjected to continuous postponements until better results are obtained [2]. Benefits of lean implementations include reduced lead time, inventories, quality cost, and increased labor productivity [3]. The number of LP discussed in the literature ranges from four [4], five [5], seven [6], and fourteen [7-10]. Each LP contains a list of lean tools that can be used. Kanban, Kaizen, 5Why, and 5S are some common lean tools [11-12].

In this era of the Fourth Industrial Revolution, SMEs must work harder to compete with larger corporations. SMEs are the backbone of the local economy in many developing countries, providing employment and growth to the country. Malaysia's GDP grew by 8.9% in the second quarter of 2022 (Q2 2022), outpacing the 5.0% growth rate in the first quarter of 2022 (Q1 2022) [13]. The increasing percentage indicates that SMEs are becoming increasingly important, and they are also the true backbone of the economy of all company enterprises in Malaysia.

Using LP in SME businesses helps to improve efficiency, eliminate waste, and promote production. However, many Malaysian SMEs are still unfamiliar with LP. As with many other improvement strategies, the organization must comprehend the various aspects of the strategy itself. Traditionally, such knowledge has been obtained through training and workshops, which can be conducted in person or via an online platform. Web-based training (WBT) has grown in popularity in recent years as more businesses strive to have easy access to training materials at lower costs. WBT consists of instructions that are delivered through a web-based or online environment. It is also known as virtual training or remote learning because it makes use of cloud computing capabilities for access, administration,

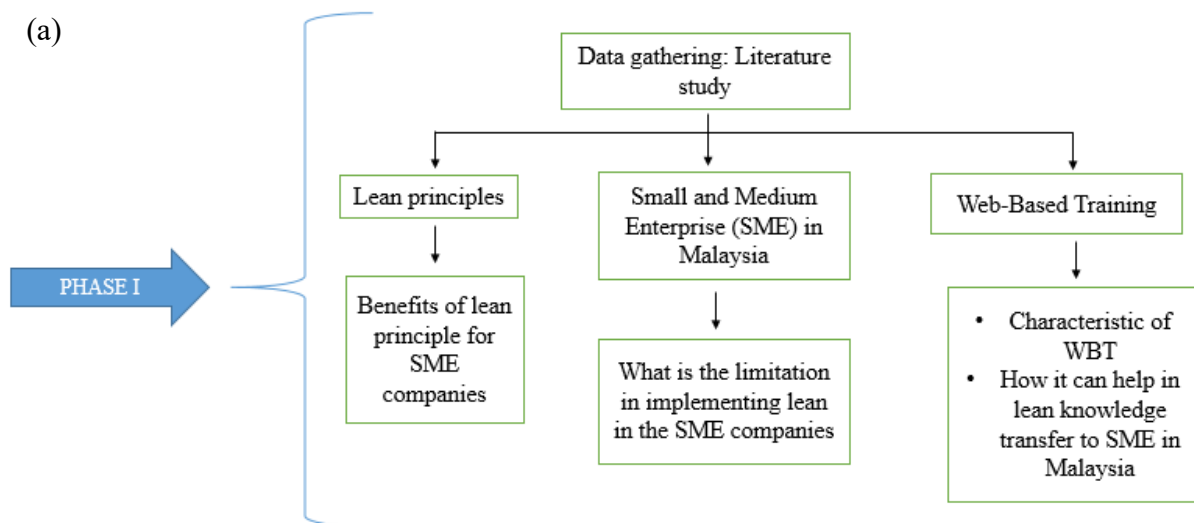
dissemination, and analytics. It is commonly used for online tutoring, seminars, meetings, webinars, and teleconferences. WBT has been established for many fields [14] and is a recognized channel for expanding one's knowledge [15].

This paper discusses the relationship between LP, SME, and WBT, followed by the WBT development process for SME adaptation. The WBT is expected to benefit Malaysian SMEs by encouraging them to introduce and implement LP in order to increase their organizations' productivity and output.

2. Methodology

The methodology concept that applies to this research is known as mixed-methods research. Mixed-methods research combines both qualitative and quantitative methods to gain a more comprehensive understanding of a research problem or question. This study is divided into two phases, as shown in Fig. 1a (Phase I) and 1b (Phase II). In Phase I, a literature study on review of research publications on the topics of LP, SME, and WBT, spanning over a period of 10 years (2002-2022) is conducted. A literature study is used to review existing research on the benefits of implementation LP in SME companies, SME companies in Malaysia in terms of the limitations to implement lean in their companies and the characteristic and how the WBT can help in transferring the knowledge to people in SME companies. This can provide valuable insights into the key factors that contribute to successful lean implementation, as well as the common challenges and limitations faced by SMEs. The review serves as a foundation for understanding these topics and how they relate to one another. The list of limitations is then divided into four categories in order to categories the LP.

In Phase II, an online survey is created to confirm and compare the findings from Phase I. A survey is used to collect data from random SME businesses from various industries. The questionnaire was distributed to 100 Malaysian SMEs via an online survey. Respondents were asked to rank the barriers to the deployment of LP in their organizations. In this case, respondents would rank the four factors identified in Phase I, with rank one indicating the most critical reason limiting implementation and rank four indicating the least critical reason. The survey also includes Likert scale questions to gather quantitative data on the limitations ranking based on their companies' taught of implementing LP, and to measure the extent of their knowledge on the LP listed. The LP in the questionnaire for the survey was based on the 14 key LP listed in Toyota Production Systems (TPS). The respondents were asked to identify the level to which they could convey their grasp of a particular LP on a five-point Likert scale, with 1 indicating "very not related" and 5 indicating "very related". The use of the Likert scale method in surveys can provide valuable insights into respondents' attitudes and opinions on a specific topic, allowing researchers to better understand the views and perspectives of the target population. The survey results were analyzed to determine the topic for the WBT module.



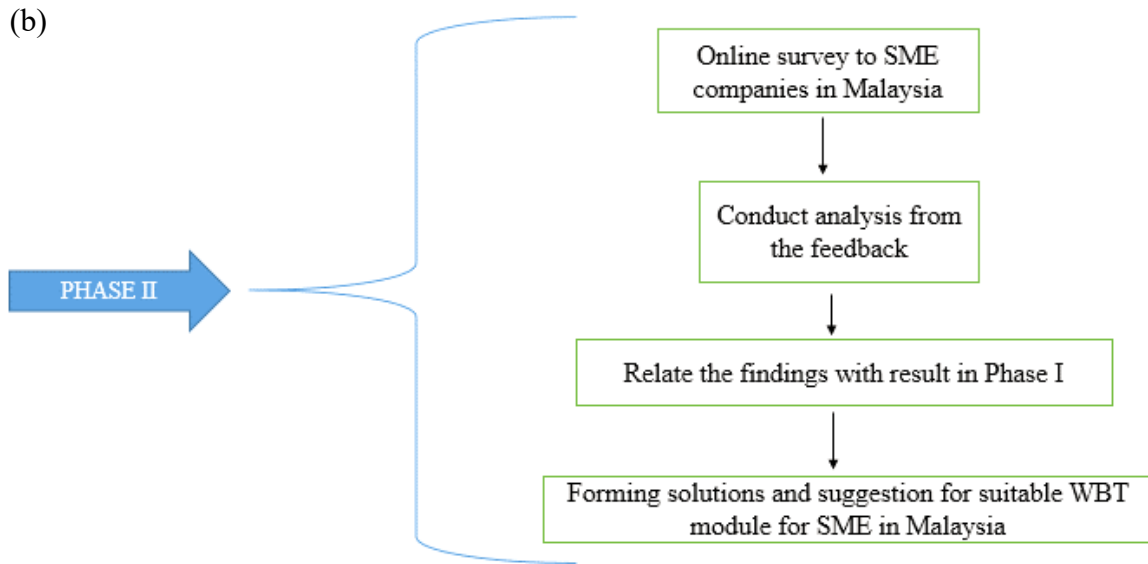


Fig. 1 - Phase study for LP in SME in Malaysia (a) Phase I; (b) Phase II

3. Result and Discussions

As compared to LP, lean tools are much more widely discussed in the literature. Lean tools have been more extensively discussed by previous researchers compared to lean principles because the tools are more tangible and easier to measure. On the other hand, LP are more abstract and difficult to measure. LP are the underlying concepts and philosophies that guide the implementation of lean tools. These principles include concepts such as continuous improvement, waste reduction, and respect for people. While these principles are critical to the success of lean implementation, they are more difficult to measure and evaluate in a quantitative way. However, it is important to note that without a strong understanding of the underlying principles, the tools can be applied in a superficial or ineffective way. Therefore, it is important for researchers and practitioners to not only focus on the tools, but also on the principles that guide their use. By doing so, they can ensure that lean implementation is done in a way that is effective, sustainable, and aligned with the core values of lean thinking. In this study, to establish the connection between LP and Malaysian SMEs, it is important to understand their conditions and situations. For example, the Toyota Production System (TPS), shown in Table 1, offer the conceptual basis essential for success in a lean system.

Table 1 - The 14 principles of The Toyota Way

Principles	TPS Lean principles
P1	Company has a long-term philosophy, even at the expense of short-term financial goals
P2	Company implements continuous process flow (Just-in-time)
P3	Company implements pull system
P4	Company implements level out the workload (heijunka)
P5	Company applies culture of stopping to fix problems, to get quality right at the first time (poka yoke)
P6	Company standardizes the tasks as the foundation for continuous improvements and employee empowerment
P7	Company implements visual control
P8	Company uses only reliable, thoroughly tested technology that serves people and process
P9	company grows leaders who thoroughly understands the work, live philosophy and teach it to others
P10	Company develops exceptional people and teams who follow company's philosophy
P11	Company respects extended network of partners and suppliers by challenging them and helping them improve
P12	Company implements gemba walk and 'see for yourself' to thoroughly understand the situation (Genchi Genbutsu)
P13	Company makes decision slowly by consensus (use cross functional teams), thoroughly considering all options; implement decisions rapidly
P14	Company becomes a learning organization through relentless reflection (hansei) and continuous improvements (Kaizen)

3.1 Limitation of Implementation Lean Principles in SME Companies

The lean implementation may face a number of challenges, such as the lack of knowledge on the lean topics due to insufficient training, lack of commitment and support from the management, insufficient preparation, limited financial and human resources, lack of organizational communication, employee attitude, limited time, and lack of communication skills. The limitations to implementing lean are reanalyzed and simplified into four categories, namely, leadership factor [16] organizational culture [17-18] financial capabilities [19-20], and skill and expertise [21]. Many studies have shown that these four categories are the common factors that have hampered lean implementation in SMEs [22-23]. Table 2 summarizes the findings of previous studies on limitations, categories of limitations, and the LP involved for each limitation. Following that, the category of limitation is elaborated further.

Table 2 - Limitations to implement lean manufacturing in SME companies

Limitations	Category of limitation	Lean principle involved
Lack of a proper framework in business [24-25]	Leadership	P1,P13,P14
Shortage of skilled and talented personnel [26-29]	Skill and expertise	P9
Limited ability to respond to the difficulties of market liberalization and globalization [30]	Skill and expertise	P11
Inadequate ability to manage technology and acquire Information [31-33]	Skill and expertise	P8
Poor output of productivity and quality [37]	Skill and expertise	P2, P3, P4, P5, P6, P7, P12
Limited access to cash and finance, as well as investment funds' immaturity in initial [27-28][38-39]	Finance	P2, P13
Lack of knowledge and understanding in LM [28][40-42]	Skill and expertise	P9
Frequent quick the job [41][43]	Organizational culture	P9, P10
Organization culture [27][40-41][44]	Organization culture	P5, P14
Lack of employee commitment and involvement [28][45]	Leadership	P9, P10

Organizational culture. Organizational culture is influenced by factors such as management's ability to function in a diverse setting, their comfort with change, and their long-term emphasis on their duties. Some researchers stated that lean implementation would be difficult in the culture of SMEs, despite the fact that SMEs are more flexible than large corporations [46]. Because SMEs have fewer management personnel, changes can be implemented quickly, resulting in easier organizational decision-making. However, cultural barriers can have an impact on small business attitudes, training, and skill development. The reasons for this cultural difference between SMEs and large corporations could be due to a lack of economies of scale, product types, and technology categories used in SMEs. The personality of the SME manager can also have an impact on the culture and success of the SME organization. A company's culture is defined by how it conducts business and manages itself. A supportive organizational culture is essential for successful lean implementation. A high-performing organization, for example, has a culture of continuous and proactive improvement. Most large organizations understand the significance of company culture. In contrast, many SMEs continue to reflect the owner's personality in their culture, limiting their ability to improve [47]. Furthermore, while some SMEs have chosen to implement lean methods successfully, their employees have shown significant resistance. Their resistance stemmed from a lack of individual knowledge, which was exacerbated by group effects because staff did not understand the tools and were unable to see the benefits [48]. As a result, it is critical for top management to be more knowledgeable than their employees.

Leadership. The top management should have a clear vision and strategic ambitions, as well as a high level of knowledge and enthusiasm to support productivity-enhancing initiatives such as lean manufacturing [49]. The commitment of the top, particularly senior management, is critical to the effective implementation of lean manufacturing [23]. However, due to the lengthy duration of some projects, management's commitment to lean activities may wane over time. This will have an impact on employee involvement in their daily improvement activities, as well as the leadership's commitment to lean implementations. Thus, leadership and management involvements are two factors that limit the implementation of lean in SMEs. Lean can be implemented successfully if the companies have strong leadership qualities and excellent project management styles. Good leadership will promote the development of effective skills and knowledge within the organization [22]. From the knowledge gained, the SMEs will be benefited from new ideas and technologies for their business affordability. According to the literature, owner-managers who lack tactful management skills [50] are more likely to fail. Many SMEs are strategically handicapped due to the lack of strong strategic drives from good leadership attributes. According to a report, SMEs believe that leadership adds no value, so they priorities product improvement over management skills [23].

Financial capabilities. The financial capabilities refer to the budget available to invest in any lean project. It has been discovered that SMEs do not normally priorities the discussion and allocation for lean projects due to uncertainties about the cost of implementation and the expected benefits. Most of them believe that implementing lean manufacturing will be costly and time-consuming [51-52], requiring significant financial investments such as hiring consultants, costs to implement lean ideas, and employee training. However, the costs incurred in implementing lean projects can be recovered by the resulting improvements in competitiveness by accelerating innovation and production, increasing flexibility, and lowering costs [53]. Thus, with proper budgeting, SMEs should be able to begin improvement initiatives involving lean consultation and training. Unfortunately, SMEs were found to be financially incompetent and to have weak financing arrangements in surveys, making it difficult to engage in any new improvement activities because they may not have this level of funding available [54]. Furthermore, successful lean implementation typically necessitates the procurement of advanced technology at high costs, which may not be appropriate for the technical competency level of SME workers [55]. Budgets for training and staff development are typically restrained by a desire to meet short-term objectives [56-57]. In addition, some managements are hesitant to devote resources to lean projects that are typically long-term in nature. As a result, even if they invest in implementation costs, small businesses will continue to miss out on the practical and intangible benefits of lean.

Skill and expertise. Qualifications and intellectual capital are frequently in short supply for small businesses. Many SMEs have expressed concern about the increased complexity of product development and manufacturing processes, which necessitate skilled labor. Most SMEs hire employees with low skill levels and do not encourage skill development in the current environment. In contrast, lean implementation is required. Participation of a specialist or an industrial engineer appears to be critical for companies aspiring to carry out product development initiatives. Skill and knowledge are important because they work together to enable the team leader to change habits and improve performance. Skill and expertise are critical even for the most fundamental core of lean improvement strategies. The most nominal approach for teaching these principles is through practice. Another challenge for SMEs is that their low-level employee skills cannot keep up with rapidly evolving technologies. Some SMEs were unfamiliar with the concept of LM, which resulted in many business owners who are excellent technicians but lack managerial or lean training [58-59]. The lack of skill and expertise is linked to the company's financial capabilities, as hiring highly skilled personnel can be expensive. As a result of limited financial resources and a low preference for hiring highly experienced engineers, SMEs frequently hire young industrial engineers fresh out of university or engage with external consultants [60].

When implementing LP, SMEs may face some challenges, but these challenges can be overcome by investing in training, change management, and strategic planning. SMEs can achieve long-term success and growth by focusing on continuous improvement and committing to LP.

3.2 Survey to SME Companies in Malaysia

In this section, the findings from each of the limitation categories are discussed in depth. One hundred diverse SME were invited to participate in the survey. The obtained response rate was 66% (66 respondents), as depicted in Figure 2.

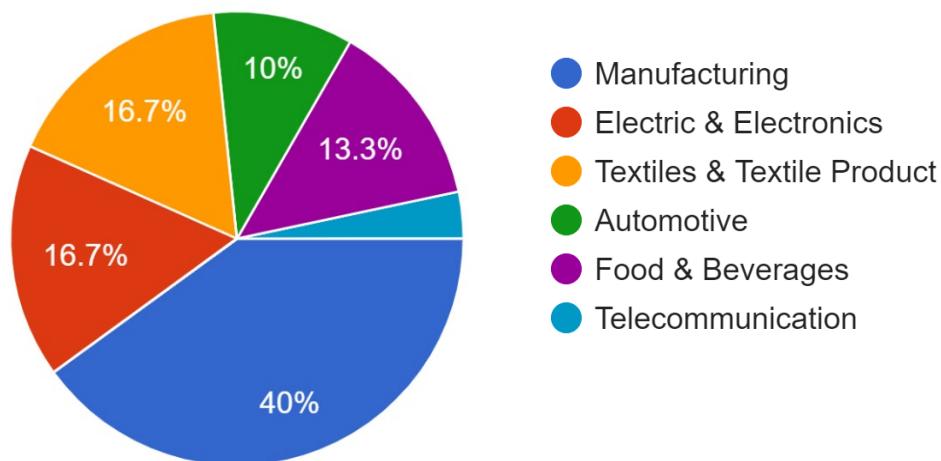


Fig. 2 - Industry background of respondent

According to respondents' responses to barriers to lean implementation in their organizations, financial constraints are the most significant impediment to lean implementation, followed by skill and knowledge, leadership, and, finally, organizational culture, as shown in Figure 3. However, because not all LP involve monetary compensation, the

response should be validated by evaluating their subsequent feedback on LP comprehension. A high percentage of comprehension of their company’s relationship to each LP indicates that the respondent understands what the LP entails. According to the results of the second part of the survey on LP knowledge, P2, P7, and P12 are the principles that Malaysian SMEs most understand, as shown in Figure 4. Furthermore, the majority of respondents have a neutral understanding of the other LP listed. The company that respects its extensive network of partners and suppliers by pushing and assisting them in improving (P11) has a high percentage of neutral understanding (66.7%) out of 14 LP. This could indicate that SMEs in Malaysia lack the knowledge to assist others in improving their businesses, as they are more likely to compete among themselves for increased profit for their own companies.

When the findings of Phase I and Phase II are compared, it becomes clear that knowledge is an important factor. Respondents with a neutral comprehension of the LP indicate that they are unfamiliar with it. As a result, it is critical to educate all Malaysian SMEs on lean manufacturing topics. According to the findings of the literature studies, the limitation to implementing lean in SME enterprises includes more than 50% of the LP listed in TPS. According to the survey, P1, P13, and P14 received the most responses with “extremely unrelated” and “unrelated” responses. Such responses demonstrate the companies’ lack of leadership abilities.

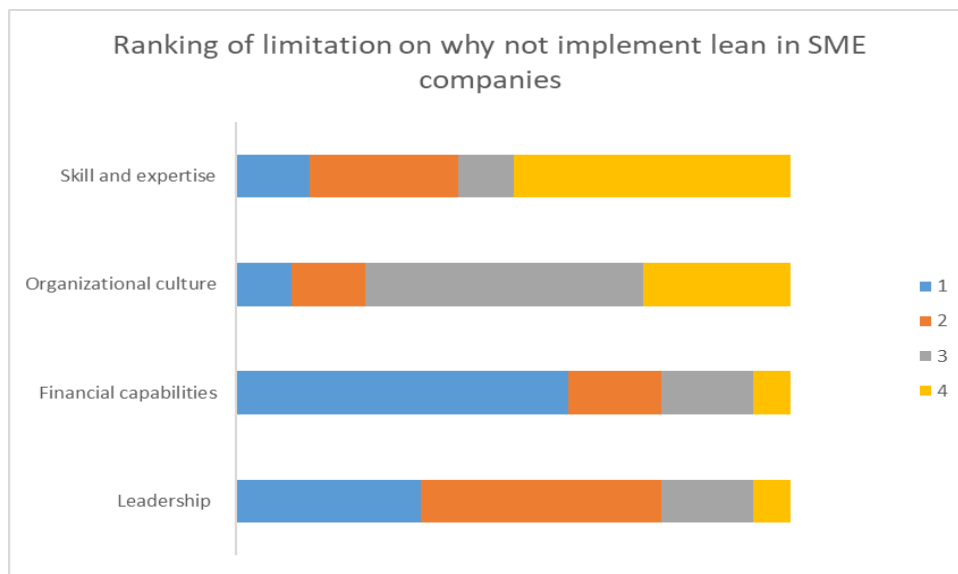


Fig. 3 - Ranking of limitation to implement lean principle by SME in Malaysia

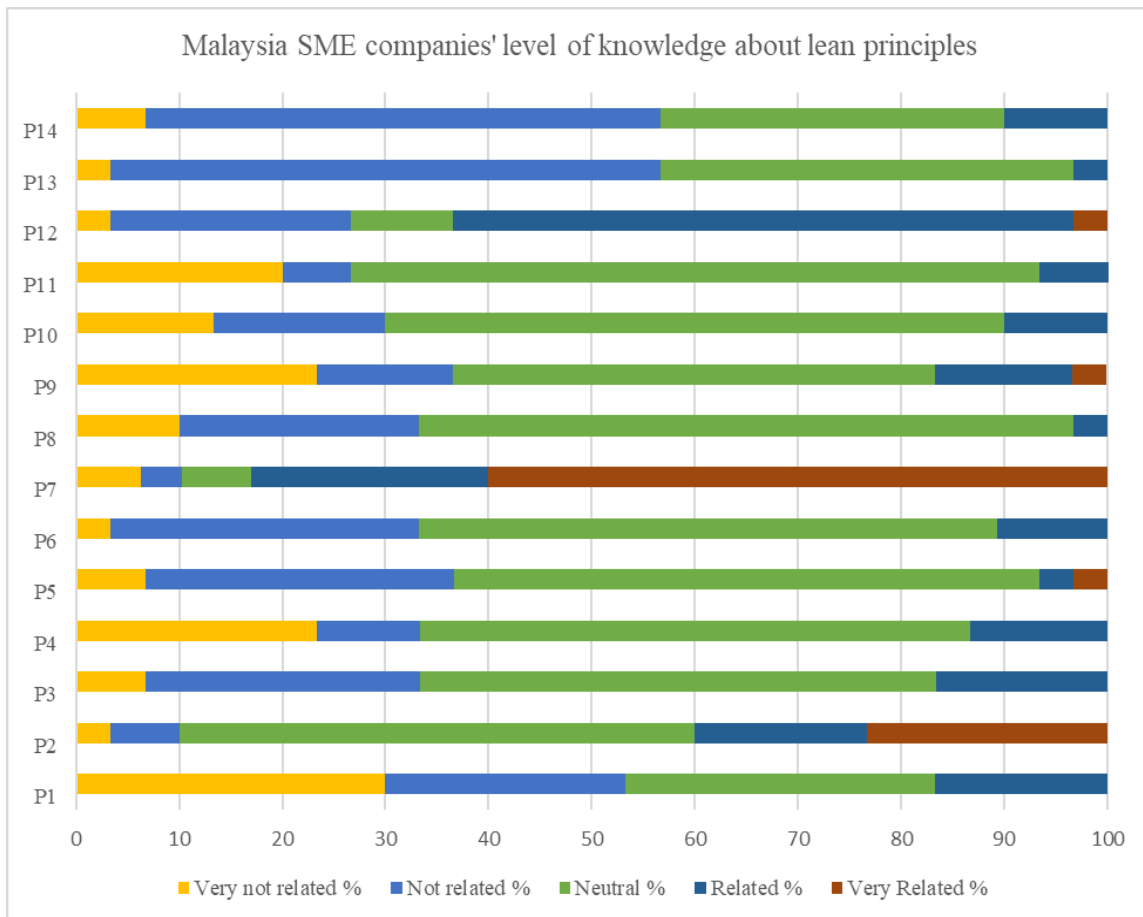


Fig. 4 - Respond on level of knowledge understanding each lean principle by SME in Malaysia

3.3 Creating an Open Access Web-Based Training

Knowledge of LP is required for implementing them in SME businesses. It will be difficult to implement these principles effectively unless they are thoroughly understood. Knowledge can assist SMEs in identifying areas for improvement, developing a lean culture, improving customer satisfaction, and increasing profitability. Because knowledge is an important factor in LP implementation, the organization’s top management must learn about lean so that they understand and know what their company must accomplish. Once top management understands LP, they can even create a lean culture in their organization. A Lean culture is essential for the successful implementation of Lean principles in SMEs. Knowledge of LP assists SMEs in developing a culture of continuous improvement in which every employee participates in identifying and eliminating waste. To address the issue of a lack of funds and limited time available to attend face-to-face training, this project proposes an open-access WBT platform for Malaysian SME businesses. The WBT was developed and is now a part of the training in the Industrial and Operations Management Research Group website, which can be found at (<https://ieom.eng.usm.my/online-training-module/>) in the School of Mechanical Engineering, Universiti Sains Malaysia. It was developed for SME owners or their top managements. As part of the initial stage, 100 Malaysian SME companies were contacted via email to announce the launching of a free training online training course. The training courses were hosted online, and participants can enroll by registering and partaking in training at their own pace and time. The first module (Module 1) was created based on the five LP that were prioritized by top management. The 5 LP is divided into five points: identifying value, mapping the value stream, establishing flow, implementing a pull mechanism, and achieving perfection. The module employs simple language and terminology to make it understandable to participants of all levels, including those with limited technical comprehension abilities. Figure 5 shows the registration down bar mode on the website before and after registration. Users can access the module’s contents after registering.

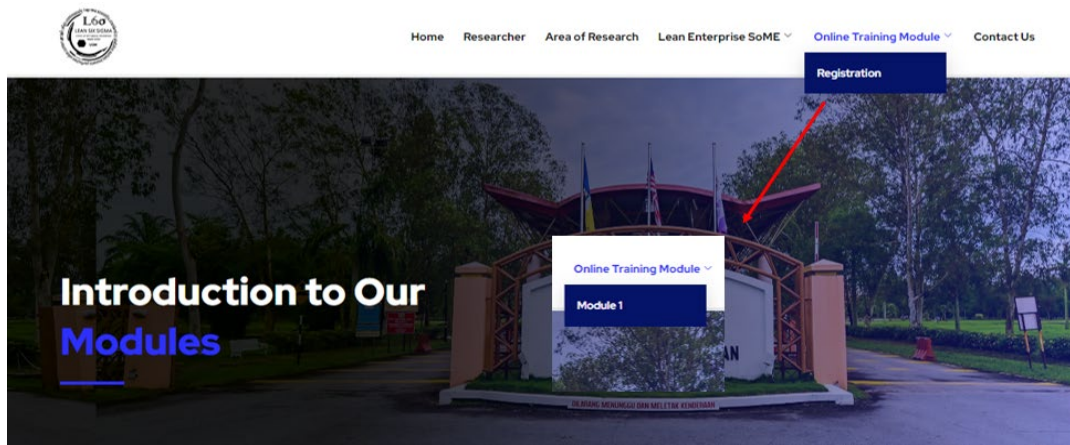


Fig. 5 - WBT module created for SME companies in Malaysia

4. Conclusion

Finally, implementing LP in Malaysian SMEs can provide significant benefits. LP are the guidelines that a company must follow in order to become a lean organization. The Lean approach can assist SMEs in reducing waste, improving quality, increasing efficiency, and lowering costs, resulting in increased profitability and competitiveness. However, implementing Lean principles necessitates knowledge, commitment, and a willingness to change existing business processes. As a result, SMEs should invest money and time in training and development programs to improve the skills and knowledge of their workforce and foster a culture of continuous improvement. Furthermore, the Malaysian government can assist SMEs by providing training and financial assistance to assist SMEs in adopting LP. Overall, with the right approach and support, implementing LP in Malaysian SMEs can yield significant benefits and help these businesses thrive in today's competitive business environment. The four major limitation categories were identified and discussed in this paper, while a survey of Malaysian SMEs revealed that LP related to leadership had the least comprehension among the respondents. As a consequence, this serves as the foundation for the creation of the first module created for the WBT on the LP for top management. Future work will thoroughly evaluate the WBT response from participating SMEs, and additional modules will be added to the WBT.

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