

Enablers and Barriers of Lean Manufacturing Implementation in Indonesian Manufacturing Companies



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Abstract Various previous studies stated that the success rate of implementing the Lean Manufacturing (LM) strategy varies greatly depending on the readiness of the organization, the readiness of individual employees, and also the work environment/work culture that has existed so far. Previous research was also mostly carried out in developed countries that had long implemented this Lean strategy, but very limited was done in developing countries like Indonesia. This study aims to complement and enrich the results of research on the implementation of Lean in developing countries, especially Indonesia. A survey method distributed 100 questionnaires, with 32% of them eligible for further processing. Using the Cochran test method, four enablers were found to significantly affect the success of Lean implementation, namely: top management commitment and support, high employee involvement, synergic cooperation of production and maintenance, and integration of LM with other programs. The accompanying results also revealed that there were five barriers believed to significantly influence the successful implementation of Lean.

Keywords Lean manufacturing · Enablers and barriers · Cochran test

1 Introduction

Lean manufacturing (LM) is an organized effort to improve production efficiency and is typically carried out by companies to prevent budget and production waste. Today, LM is a very important part of many large companies which executions

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may vary, whether systemic or systematic, in identifying and eliminating all types of production wastes and activities. Several successful implementations [1–4] and failed attempts [2, 4, 5] have been reported from notably developed countries but not from the developing ones; hence, the execution of the current research in Indonesia.

A previous study in the Iran manufacturing industry revealed that there were at least five significant practices for LM, including processes and equipment, supplier relationships, planning and control, customer relations, and human resources [6]. In a parallel study with an analytical hierarchy process (AHP), such practices may include Kaizen, TPM, and 5S [7]. In a similar manner, the current study evaluated various enablers and barriers which might affect the accomplishment of LM implementation in Indonesia's manufacturing industry. There were six LM enablers being evaluated, including: (1) top management commitment, (2) employee involvement and training, (3) dedicated suppliers, (4) synergic cooperation of production and maintenance, (5) LM integration with other programs (TPM, Six Sigma, TQM), and (6) supported infrastructure and information and communications technology (ICT), [8–10]. Simultaneously, eight barriers were also evaluated, including: (1) high rejection rate, (2) high setup and lead times, (3) high inventory level, (4) lack of top management commitment, (5) lack of employee involvement and training, (6) low overall equipment effectiveness (OEE), (7) lack of infrastructure and ICT, and (8) lack of dedicated suppliers [10, 11].

2 Methodology

This research employed a survey method to collect data from various industries located at several industrial centers in Indonesia. All enlisted enablers and barriers were broken down into sixteen questions that were embedded in a questionnaire. Considering that the number of medium and large industries in Indonesia as of 2019 was 24,529 companies, and with an assumption that 5% of them have implemented LM, then the hypothetical total population of the survey was 1,227 companies. The ideal number of samples to be taken should be 5% (63 companies) out of the total population. However, due to time and cost limitations, samples were drawn only from 12 companies out of 3 industrial estates in Greater Jakarta (Jabodetabek). Questionnaires were distributed to a total of 100 respondents, with an allocation of 8–10 participants per company whose positions were in the middle or upper managerial level. A total of 32 returned questionnaires were then found to be suitable for further process and analysis.

Table 1 Percentage of respondents agreeing with the suggested LM enablers

Tested LM enablers	In agreement (%)
Top management support and involvement	92.64
Employee training and education	88.23
Dedicated suppliers	64.70
Synergic cooperation of production and maintenance	83.82
LM integration with other programs	83.82
Supported infrastructure and ICT	66.18

3 Results

3.1 The Enablers of LM Implementation

The respondents of the study were asked whether each of the enablers included in the questionnaire was capable of affecting the success rate of LM implementation by answering “Yes” or “No”. The results are presented in Table 1.

The evaluation to measure the significance of each enabler using the Cochran test, with a critical limit of 11.070 (Chi-Square value of Q_{table} for $\alpha = 5\%$ and $k = 6$ or $df = 5$), resulted in the removal of two least-agreed enablers, i.e., ‘dedicated suppliers’ and ‘supported infrastructure and ICT’. Therefore, only four remaining factors were considered to be significant in affecting the success rate of the LM implementation.

3.2 The Barriers to LM Implementation

In a similar manner, various responses were recorded on the inhibiting factors (barriers) that might affect the implementation of LM (Table 2). Four factors were seen to have an in-agreement percentage greater than 70%, where the ‘lack of management commitment and support’ was observed as the most substantial barrier, while at the opposite end, the ‘lack of dedicated suppliers’ was observed to be the least notable barrier with a value of 57.69%.

Similar to the enablers, a Cochran test was also conducted to evaluate which factors significantly and genuinely acted as barriers to the LM implementation. Based on the critical value of 14.067 ($\alpha = 0.05$, $k = 8$, or $df = 7$), three least-agreed barriers were then removed, i.e., the ‘high level of inventory’, ‘lack of dedicated suppliers’, and ‘lack of infrastructure and ICT’.

Table 2 Percentage of respondents agreeing with the suggested LM barriers

Tested LM barriers	In agreement (%)
Lack of management commitment and support	92.30
Lack of employee involvement and training	84.62
Low overall equipment effectiveness (OEE)	79.15
High rejection rates	71.15
High setup and lead times	69.23
High level of inventory	65.38
Lack of dedicated suppliers	57.69
Lack of infrastructure and ICT	65.38

4 Discussion

4.1 LM Enablers

Surveyed industrial practitioners agreed that there are four important enablers that can be considered significant factors in the implementation of LM in Indonesia, including: (1) top management support and involvement, (2) high employee involvement and training, (3) synergic cooperation of production and maintenance and, (4) integration with other programs. Each with the respondent's selection rate of 92.64%, 88.23%, 83.82% and 83.82%, respectively.

The 'top management support and involvement' became the most preferred and was considered to be the most important in determining the success of Lean implementation. The enabler is very much needed for the implementation of any new program and policy in which top management should lay down rules and regulations for the effective implementation of an LM program. It is broadly accepted that every change in business and work needs commitment and leadership, especially from top management [12, 13], considering its critical position, functions, and responsibilities to lead a change. Since LM implementation affects an organizational structure, workers' attitudes, values, and above all, cultural change (individual and organizational) [12, 14], it is almost impossible to carry out the process without commitment, support, and involvement from this supreme administrative.

Employee involvement followed in the second position of highly important enabler. The rationale behind this was mostly because without the involvement of the employee, thoroughly and continually, any planned for changes may suffer from failure. Top management of the organization usually motivates its employees through awards, financial incentives, or empowerment to ensure the success of the LM program. The management for 'synergic cooperation of production and maintenance' was surprisingly entailed as the thirdly prioritized enabler since LM implementation, without any doubt, requires cooperation from the external units for maintenance.

Any production optimization program would be rendered to be unsuccessful if the machines often malfunctioned.

The last priority was given to the ‘integration with other program’ enabler. Nonetheless, it has to be underlined that LM (through TPM) acts as the cornerstone for many Lean initiatives. Ahuja and Khamba [15] showed this through their pyramid blocks, exhibiting the relationship between LM, TPM, and other philosophies such as TQM, JIT, and Six Sigma.

4.2 LM Barriers

In a simultaneous result, only five LM barriers were deemed to be significant in the current study, including: (1) the lack of top management commitment (92.30%), (2) lack of employee involvement (84.62%), (3) low OEE (79.15%), (4) high rejection rate (71.15%), and (5) high setup (69.23%).

The ‘top management lack of commitment’ was the main concern for companies with a Lean implementation program. The lack of top management commitment could come from various reasons, such as the lack of experience and training, reluctance to change, and hesitation to start the improvement program. With an antagonistic effect as opposed to the first enabler, the absence of management support leads to the premature failure of an LM program. Similar to their counterpart enablers, ‘employee involvement’ was also an integral and important part of the LM implementation strategy. The concept involved participation from all departments, including engineering, operations, and maintenance. Insufficient employee involvement leads to undetected and uncorrected equipment problems, and on top of that, failure in modifications and improvements.

The remaining three barriers of ‘low OEE, high rejection rate, and high setup time’ can be treated as an integrated component and discussed simultaneously. The OEE value is a multiplication of availability rate (Ar), performance rate (Pr), and quality rate (Qr) [15–17]. The availability rate is significantly affected by the breakdown and setup rates, Pr is affected by the speed losses and minor idling, and Qr is dependent on the rejection and reworking rates. The ‘high rejection rate’ and ‘setup time’ is inversely related to Qr and Ar , thus lowering the rates of both factors [18–20]. Furthermore, the decline of Ar and Qr would end up in the decline of OEE value, too.

5 Conclusions

Two main findings can be derived from the results of the current study. First of all, industrial practitioners believed that four factors could facilitate the implementation of LM in the industries, including the ‘top management support and involvement, high employee involvement and training, synergic cooperation of production and

maintenance, and dan the integration of LM with other programs. On the other hand, there were five noticeable inhibitors for the LM implementation, including the lack of management commitment and support, lack of employee involvement and training, low OEE, high rejection rate, high setup time, and high lead time. Since all enablers and barriers were rated by various manufacturing companies that have been working in an LM program, any stakeholders who have an interest in implementing LM in their organizations can focus their resources on the sorted factors mentioned in the results for a higher prospect of implementation.

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