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An Influence of Lean Manufacturing Practices on Firm Performance Measured by Balanced Scorecard: A Case Study of Manufacturing Firms in Thailand

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Abstract

The study aimed to (1) investigate the extent and level of lean manufacturing practices as well as firm performance measured by balance scorecard of manufacturing firms in Thailand, and to (2) examine the influence of lean manufacturing practices on firm performance measured by balanced scorecard of manufacturing firms in Thailand. By using simple random sampling, 400 medium-sized manufacturing firms were used as samples in this study. Descriptive analysis, correlation matrix, and multiple regressions were used to analyze the data. The study found JIT implementation and waste elimination practices were in a high level of influence, whilst participation was in a medium level. Regarding firm performance, all perspectives of balanced scorecard were in high level. In addition, the study found a positive influence of waste elimination on balanced scorecard, while there was no significant influence of participation and JIT implementation on balanced scorecard. The main value of this study is its contribution to formulating national policy based on two disparate aspects of the academic discipline of management science. Manufacturing firms can consider the benefit of lean manufacturing practices in both financial and non-financial performance. In terms of research limitations, the study focused only on a small number of medium-sized manufacturing firms in Thailand.

Keywords: Lean manufacturing practices, Firm performance, Balanced scorecard, Manufacturing firms, JIT implementation, Waste elimination, Participation, Thailand.
JEL Classification: M11; M41.

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Contribution of this paper to the literature

The study aimed to (1) investigate the extent and level of lean manufacturing practices as well as firm performance measured by balance scorecard of manufacturing firms in Thailand, and to (2) examine the influence of lean manufacturing practices on firm performance measured by balanced scorecard of manufacturing firms in Thailand.

1. Introduction

In today's world, manufacturing firms have faced with rapidly changes and highly competitions. Therefore, to maximize profits, they need to work for improving quality, flexibility, and customer response time. One of common practices of manufacturing firms is the principles of lean (Motwani, 2003). Lean philosophy has derived mainly from Toyota Motor Company in the 1980's. From that time, it has been a symbol of efficiency and optimal performance (Ohno, 1988). The advantages of lean are to help the manufacturing firms in reducing cost, cycle times through a systematic approach of identifying and criminating waste through continuous improvement. Moreover, lean manufacturing is seen as a profound processes innovation that can be applied in multiple countries and industries, without being limit to its origin (Womack, Jones, & Roos, 1990) and the impact of applying the business model is to improve a company's competitiveness and performance in their respective industries (Doolen & Hacker, 2005). Lean manufacturing practices have become a critical management tool of organizations because it offer efficient systems that enhances operations through participation, waste elimination, and just-in-time (JIT) implementation which ultimately leads to both greater long-term performance and sustainable development (Sureeratanan, Napompech, & Panjakhajornsak, 2014).

One important reason why manufacturing firms need lean manufacturing practices as a managerial tool is for greater and higher performance (Vokurka, Lummus, & Krumwiede, 2007). The relationship between lean manufacturing practices and firm performance can be explained by resource-based theory pointing lean manufacturing practices as firm resources to (1) provide a competitive advantage and to (2) generate an above-average return and performance (Khanchanapong et al., 2014). Moreover, lean manufacturing practices as firm resources can add to a firm's strengths. Therefore, resources are defined by the virtue of their relationship to performance, and the relationship between lean manufacturing practices and firm performance is the key outcome of interest (Amundson, 1998). However, there are different types and measurements of firm performance, but they are normally classified into three main performances: financial performance; non-financial performance; and mixed financial and non-financial performance. In order to sustain firm's business and serve firm's stakeholder demands, both financial and non-financial performance are the most common performance measurement tool. A popular performance measurement tool that provides both financial and non-financial performance measurement is balanced scorecard (BSC) created by Kaplan and Norton (1996). BSC divides performance into four perspectives: financial, customer, internal process, and learning. It is a strategic management system that prioritizes implementation (Kaplan & Norton, 2001).

Problems relating the research were that although several previous related studies tested the influence of lean manufacturing practices on manufacturing firm performance, they only focused either on financial performance (Fullerton, McWatters, & Fawson, 2003; Fullerton & Wempe, 2009) or non-financial (operational) performance (Khanchanapong et al., 2014; Shah & Ward, 2003; Sureeratanan et al., 2014; Vokurka et al., 2007; Ward & Zhou, 2006). Only a small number of literatures examined the effect of lean manufacturing practices on both financial and non-financial performance (Yang, Hong, & Modi, 2011). Therefore, findings of lean manufacturing practice used in manufacturing firms are unclear. Another reason is that many studies regarding lean manufacturing practices were investigated mostly in developed countries such as Japan, the United States of America, Australia, the United Kingdom, and European countries, while there were only few prior related studies in emerging economic countries, especially in Thailand (Khanchanapong et al., 2014; Sureeratanan et al., 2014). Moreover, previous studies have focused on large-sized manufacturing firms rather than small-and-medium-sized manufacturing firms.

From the research problems above, the study aimed to (1) investigate the extent and level of lean manufacturing practices as well as firm performance measured by BSC of manufacturing firms in Thailand, and to (2) examine the influence of lean manufacturing practices on firm performance measured by BSC of manufacturing firms in Thailand. Therefore, there are two main questions: What are the extent and level of lean manufacturing practices and firm performance of manufacturing firms in Thailand? and Is there any possible influence of lean manufacturing practices on firm performance measured by BSC, if so how?

This study aims to contribute to existing research. Firstly, the study will shed light on the benefits of lean manufacturing practices for Thai manufacturing firms as it has already been done in other countries. Second, the study will contribute to the knowledge of lean manufacturing practices in emerging-economy nations and supplement that relating to developed countries. Next, the study's results will reveal the nature of the influence of lean manufacturing practices on firm performance measured by BSC in Thailand. Finally, the study will demonstrate how resource-based theory can be used to explain the influence of lean manufacturing practices on firm performance in Thailand.

The study adopted resource-based theory as its theoretical framework. Literature review and hypotheses were developed based on a review of previous related studies. Methods adopted includes identifying the population,

selecting a sample, data collection, variable measurement, and data analysis. The findings are presented and discussed, followed by conclusions and suggestions for future studies.

2. Theoretical Perspective

Resource-based theory was used in this study to explain an influence of lean manufacturing practices on firm performance measured by BSC of manufacturing firms in Thailand. Resource-based theory traditionally evolved from strategy management and involves seeing an organization as a combination of resources that allow for the growth of competitive advantage among respective industries (Barney, 2001; Grant, 1991; Peteraf, 1993). Wernerfelt (1984); Amit and Schoemaker (1993) and Fernandes, Mills, and Fleury (2005) noted that resources are that which a firm owns or are able to access and can be seen as ether a strength or a weakness whilst Gruber, Heinemann, Brettel, and Hungeling (2010) found that resources are ether tangible or intangible. Tangible resources are those that can physically be seen where intangible ones are difficult to identify as they are deeply rooted in a firm's history and develops over time (Silva, Gohr, & Santos, 2019).

When considering these authors views on resource-based theory, it is clear that this theory applies to lean manufacturing, as without owning the necessary strategic resources, it is impossible to apply any lean manufacturing strategies. Lewis (2000) reiterates this through his findings on the relationship between resource-based theory and lean manufacturing, whilst it was also recognized by Silva et al. (2019) especially in terms of lean manufacturing activities such as pull production and JIT systems. It was further noted that among resources most valuable to successfully implement lean manufacturing are having a qualified operational workforce and managers, machinery, workplace culture as well as appropriate training. Womack. and Jones (2003) found lean manufacturing to be an acceptable management tool in many different industries, even though the manner in which the different lean manufacturing strategies are applied are different among industries as well as specific to each company.

Resource-based theory will be applied in this study to exam the extent to which lean manufacturing strategies influence organizational performance in manufacturing firms in Thailand. With lean manufacturing practices being different among industries in different countries, the study will identify these differences, specifically regarding lean manufacturing principles such as waste reduction, participation through relevant supply chain partnerships as well as JIT systems and their effect on organizational performance.

3. Literature Review and Hypothesis Development

3.1. Lean Manufacturing Practice

In order to understand lean manufacturing practices, it is important to comprehend the meaning of Lean. Lean strategies were developed in the 1950s by Taiichi Ohno Company and Toyota Motor Company (Ohno, 1988). Motwani (2003) described lean as a business model focused on the systematic identification and removal of waste from production as well as incorporating changing and enhancing processes and providing quality products to intermediaries and ultimately the end user. Similarly, Engelund, Breum, and Friis (2009) found lean to be a waste elimination tool used by companies in order to increase profits. Browning (2000) on the other hand, noted that lean does not necessarily mean minimizing cost, cycle time or waste but rather increasing value and releasing the correct information at the correct time and place despite these production factors typically being associated with lean manufacturing practices. Lean manufacturing practices is seen as a profound processes innovation that can be applied in multiple countries and industries, and is not limit to its origin (Womack et al., 1990) and the impact of applying the business model is to improve a company's competitiveness in their respective industries (Doolen & Hacker, 2005; Oliver, Delbridge, & Lowe, 1996). Furthermore, previous studies indicated that lean strategy allows for improved quality and productivity and greater customer responsiveness (Krafcik, 1988; Nicholas, 1998) which are necessary in order to improve a company's competiveness.

Lean Manufacturing Strategies are divided into three perspectives which are participation, Just-in-time (JIT) implementation, and waste elimination. For example, the JIT inventory strategy was established through Toyota Production Systems (Sanders, Elangeswaran, & Wulfsberg, 2016). The concept of JIT involves reducing the amount of inventory stored by requiring that the necessary materials are delivered just as they are needed for production rather than having an excess of inventories stored (Harrison & van Hoek, 2008). JIT implementation has been a key tool in the development of lean manufacturing in companies in a variety of industries (Hines, 1996). In terms of participation, in the form of building integrative relationships among key partners and institutions, also forms an important part in lean manufacturing. In order to achieve these strong relationships, an understanding of what is expected by each key partner is required (Hausman, 2001). In order to build key coordinated links between key partners, strong communication and information sharing channels need to exist to establish and maintain strong integrative relationships (Berry, 1995; Holden & O'Toole, 2004).

3.2. Firm Performance Measured by Balanced Scorecard

Performance measurement systems (PMSs) are used by firms to assist effective and efficient operations by goal accomplishments (Ahmad & Zabri, 2016). PMSs are commonly split into two components; financial and non-financial. Manufacturing firms used to measure their performance based only on financial performance, but nowadays they need to measure their performance in terms of both financial and non-financial terms in order to sustain their business ,serve their stakeholders and address the issue of sustainable development. Similarly, Gomes,

Yasin, and Lisboa (2004) found that the traditional approach to performance, through focusing only on the financial component, is no longer the only feasible measure for the ever changing environment(s) we live in today.

Non-financial performance measures were thus introduced because considering only financial performance indicators were no longer sufficient in terms of looking at the overall performance of a firm (Drury, Braund, Osborne, & Tayles, 1993; Gomes et al., 2004; Preda & Watts, 2004). Non-financial performance measures are gives a strategic look into the internal information over specific periods of time which allows for an organization to respond accordingly which allows for better decisions (Ahmad & Zabri, 2016). It is clear that with these different information available, that firms are able to respond to challenges that might not have been recognizable in the past. Hoque and Adams (2011) reiterated this by pointing out that these non-financial elements are essential in improving crucial activities.

Additionally, Kartalis, Velentzas, and Broni (2013) recognized that performance management measures used by companies using both financial and non-financial components sets them ahead of those only making use of financial indicators. Non-financial elements ultimately become a tool in measuring future financial performance as well as being a strong motivational tool (Banker, Potter, & Srinivasan, 2000).

The BSC is now a commonly used performance measurement tool by which both financial and non-financial performance can be measured (Kaplan & Norton, 1996). BSC divides performance into four perspectives: financial, customer, internal process, and learning. It is a strategic management system that prioritizes implementation (Kaplan & Norton, 2001). These four perspectives shows balanced consideration to both long-term and short terms financial and non-financial objectives (Al-Naser & Mohamed, 2017). found that one specific perspective, customer satisfaction, has a positive influence on the profitability and overall competitiveness of manufacturing firms, which is in accordance with lean manufacturing's influence on customer satisfaction, as previous studies suggest (Krafcik, 1988; Nicholas, 1998). Said, HassabElnaby, and Wier (2003) studied a wider range of non-financial measures, specifically regarding the BSC, and also found that there was a positive influence on a firms' competitiveness in their respective markets. Furthermore, Bryant, Jones, and Widener (2004) reiterate that firms' implementing performance measures are also focused on non-financial measures, specifically in terms of customer satisfaction and product development, show superior overall performance than that only focused on financial performance. Based on these studies, therefore, it is clear that manufacturing firms can no longer focus on only financial performance seeing as these type of measures are considered insufficient and outdated.

3.3. Hypothesis Development

Even though there are more bundle lists of lean manufacturing practices including total quality management, total preventative maintenance, human resource management, controlled processes, productive maintenance, and involved employees, this study will pick up three main lists of lean manufacturing practices (participation, JIT implication, and waste elimination) that are available and appropriate in Thai context. Therefore, to test the influence of lean manufacturing practices consisting of participation, JIT implication, and waste elimination on firm performance measured by BSC of Thai manufacturing firms (Khanchanapong et al., 2014; Sureeratanan et al., 2014) there were three main hypotheses in this study.

In terms of participation, previous studies, particularly in the area of supply chain management, have found that participation among companies helps increase operational performance. A study of Huo (2012) suggested that external integration in form of customer integration (e.g. sharing customers' information and feedback records) and supplier integration had both direct and indirect positive influence on company performance. Similarly, Karatzas, Johnson, and Bastl (2017) studied the relationships between manufacturer and supplier in service trades, and found that exchanging information, certain adaptations as well as the level of formalization of the relationship directly contribute to the improvement of the trade's service performance. Another study by Zhang, Van Donk, and Van der Vaart (2016) also yielded similar findings which reported that inter-organizational information and communication technology (ICT) enhanced supply chain performance by having supply chain integration as the mediator. Thus, it is hypothesized that:

H1: there is a positive influence of participation on firm performance.

In terms of JIT implementation, a number of previous studies suggest that JIT implementation leads to better operational performance. Fullerton and McWatters (2001) reported that JIT implementation of firms in the US not only helped reducing inventory levels and quality costs but also enhancing customer responsiveness. In India, effective practice of JIT initiatives has positive influence on performance of manufacturing industries since the beginning of the implementation (Singh & Singh Ahuja, 2014). Likewise, the adoption of JIT in China was found to be successful in several ownership groups including foreign, state-owned and joint venture firms (Chen & Tan, 2013). In fact, the findings in China are similar to a previous study conducted by Rahman, Laosirihongthong, and Sohal (2010) who revealed that JIT implementation promotes operational performance of firms that belong to Thais, foreigners and joint ventures. Moreover, it was also concluded that JIT is applicable to both LEs and SMEs in Thailand. Based on the above evidence, it is hypothesized that:

H2: there is a positive influence of Just-in-time implementation on firm performance.

In terms of waste elimination, one of the main purposes of implementing JIT is to eliminate non-value-adding activities or waste in the manufacturing process which in turn could result in cost reduction and quality improvement (Brox & Fader, 2002; Zelbst, Green, Abshire, & Sower, 2010). A study by Phogat and Gupta (2019)

revealed that the adoption of JIT philosophy helped reducing excessive activities and spare part inventory of maintenance departments in India. The reduction was found in four different types of wastes, namely "waste of processing, waste of rejects/rework/scrap in case of poor maintenance; waste of the transport of spares, and waste of motion". Wong, Wong, and Ali (2009) who conducted research regarding lean manufacturing practices in Malaysia also reported that firms involved in their study were able to reduce costs and minimize inventory level which, to a certain extent, considered as part of operational performance improvement. Therefore, the last hypothesis is proposed as follows:

H3: there is a positive influence of waste elimination on firm performance

4. Methods

The methods used in this study were separated into three sections which are population and sample, data collection and measurement of variables, and data analysis. The population adopted in this study was all medium-sized manufacturing firms in Thailand (Ministry of Energy, 2019) and the sample adopted consisted of 400 manufacturing firms selected by using simple random sampling.

Table-1. Variables' measurement tool.

Variables	Coded as	Measurement
1. Firm performance	BSC	Five-point Likert scale
2. Participation	Staff	Five-point Likert scale
3. JIT implementation	JIT	Five-point Likert scale
4. Waste elimination	Waste	Five-point Likert scale
5. Top management	Manage	Dummy variables 1 = top management, and 0 = otherwise
6. Firm age	Age	Firm age (year)

Source: Adapted from Suttipun, Srirat, Samang, Manae, and Maithong (2018); Khanchanapong et al. (2014); Calandro and Lane (2006).

A mailed questionnaire was used to collect data from each firm sample. The questionnaire was adapted from those used in previous studies (Khanchanapong et al., 2014; Sureeratanan et al., 2014; Suttipun et al., 2018). The questionnaire was divided into three sections as follows: (1) general information related to the manufacturing firms, (2) the extent and level of lean manufacturing practices, and (3) firm performance measured by the BSC. In the first section, the general information collected related to the top management, and the firm age. The dependent variable in this study was firm performance measured by BSC (Calandro & Lane, 2006; Suttipun et al., 2018) and the independent variables were the level of lean manufacturing practices consisted of participation, JIT implementation, and waste elimination (Khanchanapong et al., 2014; Sureeratanan et al., 2014). Firm performance and lean manufacturing practices were measured based on items in the questionnaire, to which the firms responded based on a five-point Likert scale, in which 5 represents the highest level, 4, a high level, 3, a moderate level, 2, a low level, and 1 as the lowest level. The rating scale in this study was adapted from previous studies of Ghazali and Manab (2013) and Srisa-ard (2010). The answers to each item were averaged, and the mean values for each item were expressed based on five levels: 4.51-5.00 as the highest level, 3.51-4.50 as a high level, 2.51-3.50 as a moderate level, 1.51-2.50 as a low level, and 1.00-1.50 as the lowest level. The draft questionnaire was sent to three experts, who considered its content validity and credibility. In addition, the questionnaire's reliability was also measured based on Cronbach (1951) which was found to be satisfactory (0.874). Table 1 indicates the basis on which the variables used in this study were measured.

Following by two main objectives used in this study, descriptive analysis was used to investigate the extent and level of lean manufacturing practices as well as firm performance measured by BSC of manufacturing firms in Thailand, while multiple regression was used to examine the influence of lean manufacturing practices on firm performance measured by BSC of manufacturing firms in Thailand. Moreover, correlation matrix was used for multicollinearity among the six variables used in this study. The equation is indicated below. The study also conducted a sensitivity analysis for each performance perspective of BSC comprising financial, customer, internal process, and learning.

$$BSC = a + b1Staff + b2JIT + b3Waste + b4\ Manage + b5\ Age + error$$

There are

BSC = Firm performance measured by balanced scorecard.
Staff = Participation.
JIT = JIT implementation.
Waste = Waste elimination.
Manage = Top management.
Age = Firm age.

5. Findings and Discussions

From the samples of medium-sized manufacturing firms, all 400 respondents returned the questionnaires. Consequently, the findings reveal that the most common lean manufacturing practices were JIT implementation

(Mean = 3.788, SD = .834) following by waste elimination (Mean = 3.579, SD = .824) and participation (Mean = 3.090, SD = .891). Moreover, both JIT implementation and waste elimination were in high level, while participation was in medium level. In terms of firm performance measured by BSC, all perspectives of BSC consisting of financial, customer, internal process, and learning perspectives were in high level.

Table-2. Descriptive analysis of lean manufacturing practices and firm performance.

Lean manufacturing practices	Mean	S.D.	Max.	Min.	Level
Participation	3.090	.891	5	1	Medium
JIT implementation	3.788	.834	5	1	High
Waste elimination	3.579	.824	5	1	High
Balanced scorecard	Mean	S.D.	Max.	Min.	Level
Financial perspective	3.635	.718	5	1	High
Customer perspective	3.762	.768	5	1	High
Internal perspective	3.618	.646	5	1	High
Learning perspective	3.721	.684	5	2	High
Average BSC	3.699	.582	5	1	High

A correlation matrix was used to test for multicollinearity among the six variables used in this study, consisting of one dependent variable, three independent variables, and two control variables as shown in Table 3. Based on a fixed effects model for panel testing, the maximum variance inflation factor (VIF) of the correlation matrix between the variables was 2.475, which indicates that there was no multicollinearity presented by a VIF exceeding 10. The low coefficients in the correlation matrix between the variables used in the study therefore indicated that multicollinearity was unlikely to be a problem in the multiple regression. Based on the correlation coefficients between the six variables used in this study, a positively significant correlation between BSC, Staff, JIT, and Waste was also found at 0.01 level.

Table 4 indicates the outcome of multiple regression analysis testing the influence of lean manufacturing practices consisting of participation, JIT implementation, and waste elimination on firm performance measured by BSC. The results show that only Waste was positively influencing on BSC at the 0.01 level, whilst there was no significant influence of Staff and JIT on BSC at 0.05 level. Moreover, the study did not find any significant relationship between Manage, AGE, and BSC at the 0.05 level. Therefore, to summarize by hypothesis development, *H3* was accepted, while *H1* and *H2* were rejected.

The results of positive influence related to waste elimination on firm performance were similar to Brox and Fader (2002); Zelbst et al. (2010) and Phogat and Gupta (2019) findings that JIT is for eliminating non-value-adding activities or waste in the manufacturing process which in turn could result in cost reduction and quality improvement. It leads to greater and higher performance of manufacturing firms. This is because waste elimination can reduce costs and minimize inventory level which, to a certain extent, considered as part of operational performance improvement. Moreover, this is because the main goal of lean manufacturing practices are to be highly responsive to stakeholder demands by reducing waste. Therefore, when the firms can satisfy their stakeholder demands, the stakeholders will reward them by giving greater financial and non-financial performance, better image and reputation, and higher competitive advantage (Corbett & Klassen, 2006).

Table-3. Correlation matrix of variables.

Variable	BSC	Staff	JIT	Waste	Manage	Age
BSC	1	.422**	.395**	.653**	.002	.098
Staff	-	1	.412**	.475**	.124	.207*
JIT	-	-	1	.466**	.076	.012
Waste	-	-	-	1	.057	.047
Manage	-	-	-	-	1	.179
Age	-	-	-	-	-	1
Mean	3.699	3.090	3.788	3.579	.422	11.23
S.D.	.982	.891	.834	.824	.406	8.423
VIF	-	2.264	2.108	2.475	1.112	1.403

Note: ** is significant at 0.01, and * is significant at 0.05.

However, this study did not find any influence of participation and JIT implementation on firm performance. This may be because there is potential conflicts between non-financial performance (customer, internal process, and learning performances) and JIT implementation, and between participation and financial performance (Rothenberg, Pil, & Maxwell, 2001; Yang et al., 2011).

Table-4. Multiple regression.

Variables	Beta	T	Sig.
Constant	-	7.892	.000**
Staff	.126	1.280	.204
JIT	.034	.325	.746
Waste	.575	5.886	.000**
Manage	-.060	-.748	.456
Age	.056	.684	.495
R Square	.448		
Adj. R Square	.418		
F-value (sig.)	14.776 (.000**)		

Note: ** is significant at 0.01, and * is significant at 0.05.

For example, participation requires manufacturing firms having new products or market development, order fulfillment, and customer after-sales service to increase customer responsiveness through lean manufacturing practices.

The results can be mixed because this kind of lean manufacturing practice can earn customer satisfaction and enhance customer performance. On the other hand, manufacturing firms need to spend large amounts of financial resources on activities that can reduce their financial performance. Therefore, it is important for this study to test the influence of lean practices on financial and non-financial performance separately see Table 5.

Table 5 shows the results of sensitivity analysis on the influence of lean manufacturing practices on firm performance measured by BSC for each performance comprising financial, customer, internal process, and learning.

Regarding the results of financial model, the study found a positively significant influence of JIT and Waste on financial performance at 0.01 and 0.05 levels. In customer model, on the other hand, this study found a positive influence of Staff and Waste on customer performance at 0.05 and 0.01 levels.

For internal and learning models, the results indicated a positively significant influence of only Waste on internal process performance and learning performance at 0.01 level. However, the control variables used in this study are unable to find any relationship on firm performance in any models at 0.05 level.

Table-5. Sensitivity analysis model.

Variable	Financial		Customer		Internal process		Learning	
	Beta	t (sig.)	Beta	t (sig.)	Beta	t (sig.)	Beta	t (sig.)
Constant	-	4.732**	-	4.453**	-	7.828**	-	6.993**
Staff	.019	.172	.193	2.054*	.134	1.178	.066	.585
JIT	.364	3.171**	-.028	-.288	-.143	-1.196	-.101	-.846
Waste	.253	2.333*	.601	6.457**	.510	4.517**	.534	4.762**
Manage	-.068	-.774	-.112	-1.479	-.079	-.856	.069	.759
Age	.108	1.187	.077	.982	.005	.057	-.014	-.144
R2	.321		.498		.262		.272	
Adj. R2	.284		.471		.221		.232	
F (sig.)	8.622**		18.066**		6.456**		6.807**	

Note: ** is significant at 0.01, and * is significant at 0.05.

In financial model, the results of a positive influence of JIT on firm financial performance were consistent with Phogat and Gupta (2019); Yang et al. (2011); Fullerton and Wempe (2009) and Fullerton et al. (2003). The results indicate that the adoption of JIT leads to better financial performance.

The improvement could be explained by the nature of JIT as it has potential to enhance the flow of financial management, which is an effect of cost reduction, and improve product quality, which could result in customer satisfactory and profit increase (Yang et al., 2011).

In customer model, the results of positive influence of participation on firm customer performance were consistent with Huo (2012); (Ward & Zhou, 2006) and Shah and Ward (2003).

This is because participation can achieve customer satisfaction in terms of new product or market development, order fulfillment, and customer service by increasing customer responsiveness and reducing customer lead time.

Participation is also expected to improve firms' abilities in developing customer value in the form of lower product prices and quality that will enhance firms' customer performance.

6. Summaries and Suggestions for Future Study

To answer two main questions, namely what are the extent and level of lean manufacturing practices and firm performance of manufacturing firms in Thailand, and is there any possible influence of lean manufacturing practices on firm performance measured by BSC, this study found that JIT implementation and waste elimination were in

high level, while participation was in medium level. In terms of firm performance, all perspectives of BSC were in high level. In addition, the study found a positive influence of waste elimination on BSC, while there was no significant influence of participation and JIT implementation on BSC.

Results of the current study provide some contributions and implications. In terms of theoretical contributions, the findings clearly demonstrate how resource-based theory can explain the influence of lean manufacturing practices especially in the area of waste elimination on firm performance in Thailand.

The findings also expand previous studies on a positive influence of lean manufacturing practices on both financial and non-financial (operational) performance in an emerging economic country as well as developed countries.

For practical contributions, on the other hand, the study's findings can demonstrate the effectiveness of lean manufacturing practices as a valuable resource for improving both financial and non-financial performance. Thus, top-managements and owners should treat lean manufacturing practices as the firm management tools.

Investors can also gain important information from just-in-time implementation for future decision making because this bundle list of lean manufacturing practices already indicate how it can predict the higher financial performance. Finally, regulators and policy makers will implicate the advantage of lean manufacturing practices in Thailand as well as developed countries.

However, there are some limitations that should be mentioned in this study. For example, this study focused only on medium-sized manufacturing firms in Thailand where there are limited and specific industries when compared to the other regions of Thailand such as seafood manufacturing firms, plum oil and product manufacturing firms, and rubber product manufacturing firms.

Next, lean manufacturing practices used in this study was more short-term in nature, and indirect positive implications were realized over a longer period.

Finally, while this study used only participation, just-in-time implementation, and waste elimination, there are more to the bundle list of lean manufacturing practices including total quality management, total preventative maintenance, human resource management, controlled processes, productive maintenance, and involved employees. Therefore, to close the limitation gaps of the study, the suggestion for future studies is to investigate the other bundle lists of lean manufacturing practices by using secondary data of manufacturing firms in Thailand or ASEAN countries consisting of a longer periods.

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