Lean Systems Practice on Firm's Performance

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Abstract

Lean system practice is important in the organization's competitive advantages and performance to compete and survive in the world of today. The purpose of this study is to understand the causal relationship between lean practices and firm performance, with competitive advantage proposed as playing the moderating role. A survey was carried out to identify the effects of six lean practices, namely process and equipment, manufacturing planning and control, human resource practices, product design, supplier relations and customer relationship on a firm's performance, which comprise perception of financial and non-financial measures. The study comprises of 238 observations of Thai companies. The parameters are estimated by ordinary least squares (OLS). The results of this study suggest a negative relationship between lean practices and non-financial performance. Nevertheless, there appears to be a significant positive relationship between competitive advantage and the implementation of lean practices in firms. The scope of the study was limited to companies in Thailand and, therefore, its findings might not be generalizable to other national contexts.

Keywords : *Lean system practices;Firms' performance; Competitive advantage*

Introduction

Business or organization struggle with an increasingly turbulent and uncertain environment, facing complex markets, many competitors can be able to make cheaper cost (Christopher & Holweg, 2011). The supply chain is a powerful weapon, especially in complex

27 มิถุนายน 2562/ 13 กันยายน 2562/ 2 ตุลาคม 2562
27 June 2019/ 13 September 2019/ 2 October 2019

markets. It can contribute to the lowest cost and make competitiveness to the organization because the supply chain is a large portion and create the cost of around 70%-80% to the business(Premkumar, 2000).On the other hand, it could increase more cost when the company uses it in the wrong way.

The issues relating to supply chain practices have been a subject of interest to practitioners and researcher(Zhou & Benton Jr, 2007)to solve the challenge. Many organizations have increased supply chain management (SCM) practices in their organization because of the expectation of decreasing supply chain costs and securing the business (Li et al.,2006) Therefore, the firms or organization has adopted supply chain management (SCM) practices to strengthen their organizational performance.There are many practices in supply chain management. In the recent decade, firms or organization have adopted Lean practices to achieve their performance and their competitiveness. Especially, the Southeast Asia including India, Malaysia, Indonesia, Thailand, and South Korea, the majority of manufacturers that are consumed in the developing country by lowest cost of labor and low material costs(Lai, Wu, & Wong, 2013), which contribute increasing economic growth in the next decade.

These practices require that manufacturers work among supply chain partner to enhance performance. However, many manufacturers have successfully implemented lean practices; others have not achieved the expectation of performance. This challenge emerged whether the adoption of lean practices to improve their results. It is not only intra-organization that they need to expand the whole supply chain to gain the benefit of lean practices(Womack & Jones, 1996). That why lean practices should be addressed from the supply chain.

The objective of the study

This study aim to the lean systems practices on firm performance based on the case of Thailand. As the contextual problems, which can lead to research questions in the following;

- Do firms with a high level of lean systems practices have high levels of firm performance?

- Do firm with a high level of lean systems practices have competitive advantage?
- Does competitive advantage moderating affect the impacts of lean systems practices and firm performance?

To address the research questions, this paper organized as follows. Section 1, it was discusson introduction. Section 2includes literature reviews on lean system practices, competitive advantage and financial performance. Section 3, research design and methodology were developed to answer the questions of studies. Finally, the outcome of the discussion.

Literature review

Leansystems practices

The beginning of lean is from the Toyota production system (TPS), which well-known in the manufacturing industry because it is essential to eliminate waste and continuous improvement process(Womack, Womack, Jones, & Roos, 1990). Lean systems that use “pulled” from upstream to downstream as they need with necessary items, at the right time, in the right quantities(Sugimori, Kusunoki, Cho, & Uchikawa, 1977). The aims of Lean systems to integrate all the activities in the organization that impacted to goods and service and delivered to customers with zero waste while minimizing the cost and maximum efficiency(Moyano-Fuentes, Sacristán-Díaz, & Jose Martinez-Jurado, 2012).

Lean systems practicesare becoming increasingly popular to improve organizational efficiency and competitive performance by increasing performance in terms of reduced lead times, small batch sizes, fast responses, and financial performance(Chavez et al., 2015; Hofer et al.,2012). This research focused on six lean practices namely process and equipment,manufacturing planning and control, human resource practices , product design, supplier relations and customer relationship based on earlier published studies (Iranmanesh, Zailani, Hyun, Ali, & Kim, 2019).

Competitive advantage

Competitive as one of the essential factors that shape the way that things are done in a firm. The world is changed, competition shift from firm to firm and its supply chain. Organizations require understanding how to manage supply chain capture competitive advantage(Narasimhan, Narayanan, & Srinivasan, 2013). This theory is based on Porter (1989) using resources to achieve competitiveness on the market. The previous literature studied companies that implemented lean practices and reported that companies that developed competitiveness and impact to firm performance which has been identifying price/cost, quality, delivery, and flexibility as important competitiveness(Skinner, 1985).Moreover, one including time-based competition as important competitiveness(Li, Ragu-Nathan, Ragu-Nathan, & Rao, 2006).

These measurements are also defined in previous research(Rondeau, Vonderembse, & Ragu-Nathan, 2000; Sigalas & Papadakis, 2018). Based on the above, price/cost, quality, service reliability, product innovation, and time to market are the dimensions of the competitive advantage building used during this research. As such, competitive advantage has a moderating effect on the relationship between lean systems practices on firm performance.

Firm's performance

Thesuccess of supply chain management (SCM) has become a valuable way of competitive advantage and improving the performance of firms(Sigalas & Papadakis, 2018). The measure of financial performance can be split into two categories: (1) Managers' perception of market share performance, profitability, sales growth, and competitive position in the industry. (2) HR efficiency, including the morality, efficiency and engagement of employees. Objective and subjective measures were used to measure the performance of an organization. The objective measures include measures such as return on assets, market share, sales, export proportion, domestic growth rates, and sales growth for exports. Similarly, subjective performance measures include a perceived performance of management of productivity, profitability, market share, and competitor customer satisfaction(Tiwari & Tripathi, 2012).

Past studies examined firm performance using both financial and non-financial. Many research showed that lean system to be related with business performance in term of financial performance such as inventory cost,operation cost but negative impact with non-financial performance because it matrices to measure as a long-run including responsiveness, customer demand suddenly changes that depend on another function or other strategies does not relate with operational(Hussain, Jusoh, Sarfraz, & Wahla, 2018). The part in line with the above literature, the same items will be adopted to measure firm performance in this study. Therefore, theframework model and hypothesis is that:

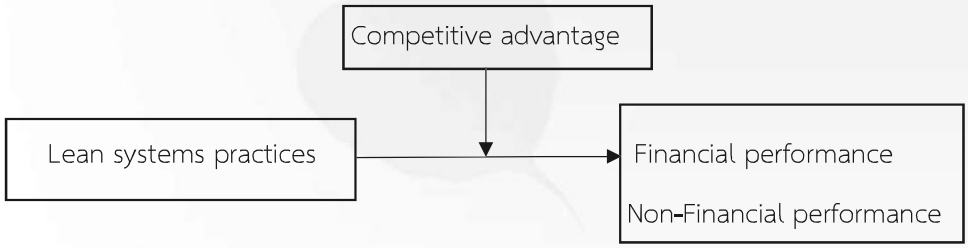

Figure 1 : Research model

Hypothesis 1: Lean systems practices positively affect financial performance.

Hypothesis 2: Lean systems practices negativelyaffect non- financial performance.

Hypothesis 3: The competitive advantage positively affectsfinancial performance.

Hypothesis 4: The competitive advantage positively affectson non-financial performance.

Hypothesis 5: Competitive advantage positively moderating effect the impacts of lean systems practices and financial performance.

Hypothesis 6: Competitive advantage positively moderating effect the impacts of lean systems practices and non-financial performance.

Research design and methodology

The multiple regression analysis was conducted to examine the study to investigatehypotheses (Hair et al., 2012). The questionnaire validated by the primary research instrument for the study.

Sample and Data Collection

In this study, organization or firms in varieties in Thailand from many industries in which five industry sectors were provided with questionnaires. The questionnaires were sent by e-mail in mid-Mar2019, and the completed questionnaires were accepted until early May2019. A total of 897 surveys were received that corresponds to approximately 26.53% of the surveys completed. A total of 238observations were intended to identify participants with the greatest understanding of the functioning and management of the lean systems practices. Participants have been clarified the research topic, objective, and the right to participate before answering the questionnaire. The majority of the respondents had similar titles to the Manufacturing Director or Plant Manager, who had an operation or production experience. The Answer The sample profile consisted of five industries in Thailand, which including 29% Automotive Industry, 12% Agricultural Industry, 21% Electronics Industry, 22% Food Industry, and 16% Garment Industry.They had an average of 5.4 years of work experience (Female 140, Male=98). The average number of employeeshad about 344 persons.

Measurement Scales

A survey instrument 31 items (questions) for lean system practices, 14 items for competitive advantage, and nine items for the firm's performance. The 31 items (questions) for lean system practices are based on earlier published studies (Iranmanesh, Zailani, Hyun, Ali, & Kim, 2019). The 14 items about competitive advantage, developed by previous studies (Li et al., 2006). Firm's performance nine items. All of them were made to the survey instrumentand confirm reliability with Cronbach's Alpha greater than 0.80. There are four equations in the regression model because of the answer research question to test the direct

effect between lean system practice with the firm's performance and the moderating effect of competitive advantage on lean system practice with firm's performance.

The parameters are estimated by ordinary least squares (OLS). However, the equations estimated using OLS ignore the effects in the other direction, including multicollinearity, heteroscedasticity, etc. As results, the use of an ordinary least squares (OLS) regression would suffer the simultaneity bias and lead to inconsistency (Wooldridge, 2016). In the next stage, we extend the analysis of the estimation by using the feasible generalized least squares (FGLS) to solve the heteroscedasticity problem.

Table 1 Research variable definitions

Variable Category	Variable names	Definition
Explained variable	Financial performance	Measuring the results of a firm's performance in monetary terms which measure by the perception of the respondent that reflected in return on investment, return on assets, sale growth,inventory cost.
	Non-Financial performance	Non-financial metrics are measures which can not be expressed in monetary terms.
Explanatory variables	Lean systems practices	Lean is a system, andthe firm's activity focused on reducing waste.
Explanatory variables	Competitive advantage	Competitive advantage is probably best understood as the factors that elevate business beyond market rivals.
	Gender	Control variable (female=1, male=0).
	Education2	Control variable as a bachelor'sdegree.
	Education3	Control variable as a higherbachelor'sdegree.
	Exper_ave	Control variable as an average on work experience.
	Type 2	Control variable as an agricultural industry.
	Type 3	Control variable as the electronics industry.
	Type 4	Control variable as the food industry.

Results

The 238 observations from fives industry sectors, All record were downloaded and imported into the Statistical Analysis System (SAS) version 9.4 to test the causal relationship in the regression model.Descriptive statistic of the dependent variable and the explanatory variables was presented in Table 2.Pearson's correlation coefficients present in Table 3. The coefficients of pearson's correlation show statistically significant relationships between competitive and non-financial performance (at $p \leq 0.05$).Also, the correlation between lean systems practices and competitive advantage (at $p \leq 0.05$) indicates positive and statistically significant that is consistent with the expectation, the higher lean systems practice level, the higher competitive advantage.

The variance of inflation factor of the explanatory variables is smaller than 4, refer to there is no perfect multicollinearity in this model, suggesting that problems associated with multicollinearity are relatively unlikely in our analysis.Besides, the best Ordinary Least Squares (OLS) need to test autocorrelation. We tested both of Durbin Watson (DW) and Godfrey statistic, which autocorrelation in the residuals from a statistical regression analysis. The results are the same (at $p \leq 0.01$).Hence, the regression model found autocorrelation.

Moreover, we test whether the variance of the errors in a regression model is constant: that is for homoscedasticity. In contrast, heteroscedasticity is most frequently discussed in terms of the assumption in the linear regression model. For testing this problem, we use the White test(White, 1980)that is similar to that by Breusch-Pagen. White test for heteroskedasticity is general because it does not rely on the normality assumptions and it is also easy to implement. The result of White's statistic testing shows that the variance of the errors in the regression model is inconstant in the financial equation. Therefore, the results of the test showed that it was not reliable.For these reasons, the model was tested,which adjusted autocorrelation and the heteroscedasticity by feasible generalized least square (FGLS) to solve the problem.

The first model for the financial model after solving the problem by FGLS. The findings indicate that no statistically significant independent variables are all supported by H1.

Exceptionally, education, type of industry, and the number of the employee are statistically significant, as shown in Table 4. The combined independent variables explained 11.7% of the financial performance ($F=3.85$, $p < 0.01$).

The second model forthe non-financial equation is homoscedasticity but found autocorrelation. We also adjusted by FGLS as Table 5. The results show that both lean systems practice and competitive advantage are statistically significant. Furthermore, the beta coefficients for the regression model were -0.138 ($p < 0.05$) for lean systems practices, reflecting their negative impact in explaining non-financial performance is supported H2. Meanwhile, the beta coefficients for the regression model were 0.186($p < 0.05$) for competitive advantage, reflecting their positive impact in explaining non-financial performance is supported H4 but is not support H3.Even if R-squared is smallR2=0.105, small p-values still show an actual relation between the crucial predictors and the answer variable(Wooldridge, 2015).

The third and The fouth model tested the interaction effect between lean practices and competitive performance is not as significant as we expected. Because of the result has shown lean systems practices relationship with the non-financial performance, which not relatestoa competitive advantage, are not support H5, H6.

As on above, the regression analysis supported H2 and H4 but not support H1,H3,H5, H6 that acceptance was not significant.

Table 2 Descriptive statistics of variables for lean systems practices on firm's performance (n=238)

Variable	*Mean*	*Std.dev.*	*Min.*	*Max.*
Financial performance	4.292	0.323	3.500	4.800
Non-financial performance	4.300	0.309	3.200	5.000
TCP: Competitive advantage	3.956	0.373	3.000	5.000
TLP: Lean systems practice	3.864	0.434	2.866	4.825
Gender_Female	0.588	0.493	0.000	1.000
Education1_Below bachelor's degree	0.105	0.307	0.000	1.000

Table 2 Descriptive statistics of variables for lean systems practices on firm's performance (n=238) (cont.)

Variable	*Mean*	*Std.dev.*	*Min.*	*Max.*
Education2_bachelor's degree	0.714	0.453	0.000	1.000
Education3_ Higher bachelor's degree	0.181	0.386	0.000	1.000
Experience_average	5.441	3.075	1.500	12.000
Automotive Industry	0.282	0.451	0.000	1.000
Agricultural Industry	0.126	0.333	0.000	1.000
Electronics Industry	0.210	0.408	0.000	1.000
Food Industry	0.218	0.414	0.000	1.000
Garment Industry	0.164	0.371	0.000	1.000
Number of Employees average	343.908	252.878	175.000	1200.000

Table 3 Pearson's correlation coefficients (n = 238)

		Finan	nonfinan	TCP	TLP
Finan	Pearson Correlation	1	0.0316	-0.03167	-0.0426
	Sig.		0.6276	0.6269	0.5131
nonfinan	Pearson Correlation	0.0316	1	0.14191	0.00357
	Sig.	0.6276		0.0286*	0.9563
TCP	Pearson Correlation	-0.03167	0.14191	1	0.75795
	Sig.	0.6269	0.0286*		<.0001**
TLP	Pearson Correlation	-0.0426	0.00357	0.75795	1
	Sig.	0.5131	0.9563	<.0001**	

Remark : * 0.05 significant level

** 0.01 significant level

Table 4 Multivariate Results after the corrected problem of heteroscedasticity byusing FGLS Lean practices on financial performance (n = 238)

Independent Variables	Estimated Coefficient	P-value	Variance Inflation Factor (VIF)
Intercept	5.163	<.0001	
TLP: Lean systems practice	-0.050	0.458	2.431
TCP: Competitive advantage	-0.054	0.508	2.522
Gender Female	0.054	0.186	1.098
Education2_ bachelor's degree	-0.300	0.000	2.945
Education3_ Higher bachelor's degree	-0.247	0.012	3.155
Experience average	-0.005	0.523	1.472
Agricultural Industry	-0.056	0.437	1.346
Electronics Industry	-0.204	0.000	1.504
Food Industry	-0.139	0.016	1.592
Garment Industry	-0.089	0.196	1.510
Number of Employees average	-0.000	<.0001	1.243
$R^{2=}$0.158 Adj. R^2=0.117			
F-Test=3.85 (P-value =0.000)			

Table 5 Multivariate Results after the corrected problem of heteroscedasticity by using FGLS Lean practices on non-financial performance (n = 238)

Independent Variables	Estimated Coefficient	P-value	Variance Inflation Factor (VIF)
Intercept	4.189	<.0001	
TLP: Lean systems practice	-0.138	0.035*	2.431
TCP: Competitive advantage	0.186	0.013*	2.523
Gender Female	-0.065	0.084	1.098
Education2_ bachelor's degree	0.042	0.496	2.946
Education3_ Higher bachelor degree	-0.115	0.120	3.155

Table 5 Multivariate Results after the corrected problem of heteroscedasticity by using FGLS Lean practices on non-financial performance (n = 238) (cont.)

Independent Variables	*Estimated Coefficient*	*P-value*	*Variance Inflation Factor (VIF)*
Experience average	-0.011	0.124	1.472
Agricultural Industry	-0.005	0.938	1.346
Electronics Industry	0.085	0.087	1.504
Food Industry	0.059	0.270	1.592
Garment Industry	-0.023	0.759	1.510
Number of Employees average	-0.000	0.265	1.243
$R^{2=}$0.146 Adj. R^2=0.105			
F-Test=3.52 (P-value =0.000)			

Remark : * 0.05significant level

** 0.01 significant level

Discussion and Managerial Implications

The result of this study is important because they show that the lean systems practices of five industries on the firm's performance. The results showed thatlean systems practices are no causal relationship with financial performance. Interesting point, lean systems practices is the causal relationship with non-financial performance. In the real world, many organizationsare aware of the importance to implement lean systempractices, they do not know how to implement, due to a lack of knowledge and deep understanding of each practice are appropriate withtheir organization.Therefore, it may be impacted by a firm's performance.

By this research, developing, and validating, an operational measure of the construct of lean systems practice, witha competitive advantage and enhancing firm performance, the present study provides managers with a useful tool for evaluating the comprehensiveness of their current lean systems practices. Through the analysis of the relationship of lean systems, practice construct with non-financial performance (H2), it was demonstrated that lean systems practice might directly negatively impact non-financial performance that consistent with Henao, R., Sarache, W., & Gómez, I. (2018). The findings of this research thus point to the

importance of lean systems practices. The organization has to realize of what supply chainmanagement practices appropriate with their firm due to lean systems practices is not always the right alternative.

Based on this above empirical result, it concludes that it is clear there is the direct negative impact of lean systems practices on non-financial performance. Furthermore, there is a positive impact of competitive advantage on non-financial performance.The study focuses on the causal relationships between lean systems practice, competitive advantage, and firm performance. On the other hand, an enhanced competitive advantageprovides a firm increased non-financial performance withlean system practices (H4), which is consistent with Sigalas, C., & Papadakis, V. M. (2018)(Li et al., 2006). Moreover, there is no interaction effect between lean systems practices on competitive advantage.

These results have a significant impact on companies or organizations and executives involved in developing their organization's lean practices. Lean systems practices on firm performance and its related core characteristics need to be represented within modeling. However, the numerous approaches relevant research gap has been identified as follows:

- Moderator variable lean systems practice, need to consider in next research such an organization's culture, information technology capability, collaborationto improve the performance of the firm.
- The study sample is limited to five industry sectors in Thailand and needs to limit the target population to a specific industry.

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