

The Relationships among Lean Production, Operational Performance and Financial Performance

Piyachat Burawat

Rajamangala University of Technology Thanyaburi, Thanyaburi, Thailand

Abstract: The objective of this study is to investigate the relationships among lean production, operational performance and firm performance; thereby, the study was conducted and accomplished by means of quantitative method using random sampling and snowball sampling. The results were analyzed by descriptive statistics, confirmatory factor analysis and the structural equation modeling by using statistical software programs. Considering the quantitative approach, a survey was conducted with 629 current middle and top managers working in Thai Manufacturing Industry. The majority of respondents were male (56.3%) of the age above 40 years old (32.6%), factory/production manager (39.1%), bachelor's degree (75.8%), working in medium size company (36.9%), nonautomotive (60.9%) and company age above 15 years (46.6%). The findings reported that, there were positive relationships between lean production and operational performance, lean production and financial performance and operational performance and financial performance. In addition, the results presented that there was partial effect of lean production on financial performance through operational performance. Considering the structural model level, the results further revealed that the model was not different across the automotive and nonautomotive industry and the model was not different across the lean production adoption <5 years and above 5 years. Regarding the path level, the results reported that all of each path model level was not different across automotive and nonautomotive industry. Similarly, the lean production adoption whether <5 years or above 5 years did not have any effect on all of the path model levels.

Key words: Lean production, operational performance, financial performance, manufacturing industry, model, relationship

INTRODUCTION

Since Thai manufacturing companies are confronting with low level of productivity (Tansakul and Sutthiwatanaruputh, 2014), higher labor cost high level of inventory (Piyachat and Chanongkorn, 2015) as well as advances in technology, science and innovation (CTAD, 2015), business leaders and managers need to explore strategies that can increase value to their goods and decrease losses as much as possible (Barney and Hesterly, 2010). Since, the time Toyota implemented lean manufacturing effectively, it has gained much attention within two decades. Overall, the reviews of related publications present that lean production implementation is repeatedly related to operational performance improvement. However, the most normally mentioned advantages associated with lean implementation are advancement in employee productivity and quality of products, along with decreasing in manufacturing costs, cycle time and customer lead time (Sakakibara *et al.*, 1997; White *et al.*, 1999; Marynell, 2013, Chanegrih and Creusier, 2016). Yet, some research reported that there is no connection between lean production and operational performance (Swink *et al.*, 2005; Hibadullah *et al.*, 2013).

Although, some studies assert the relationship between lean practice and financial performance (Fullerton and Wempe, 2009; Yang *et al.*, 2011; Chanegrih and Creusier, 2016), some studies reject this relationship (Kaplan and Norton, 1992; Fullerton *et al.*, 2003; Cannon, 2008; Jayaram *et al.*, 2008). Meanwhile, little study such as Fullerton and Wempe (2009) found that there was an effect of lean production on financial performance through operational performance.

Regarding the above concepts, the relationships among lean production, operational performance and financial performance are still vague. Therefore, this study proposes to add comprehension of these linkages by investigating the simultaneous relationships among lean production, operational performance and financial performance in Thai Manufacturing Industry. Moreover, this study intends to augment both academic and practical understanding by examining the moderate effect of type of industry and length of lean adoption on the structural model.

Literature review: Successful lean manufacturing requires participation from all of stakeholders including suppliers, all level of employees, distributors, customers,

shareholders as well as all process components (Shah and Ward, 2007). The consequences of lean practice are related to both operational and financial performance.

Lean production: Regarding academic literature, lean manufacturing, often described as Toyota Production System (TPS) was initiated in Toyota motor manufacturing company after the second world war when most Japanese firms including Toyota were facing with the challenge of managing production facilities with restricted resources (Liker, 1998).

Scholarly, community separated lean manufacturing primarily into three categories. For the first category, lean refers to activity of eliminating waste from the production system (Ohno and Bodek, 1988; Shingo, 1989; Womack *et al.*, 1990; Womack and Jones, 1996) and the ability to produce the highest quality product that delights the end consumers. In the second category, some researchers interpreted lean production as four rules of driven system. Rule 1 associates with all activities require to be specified in terms of content, sequence, timing and outcome. Rule 2 proposes that direct and unsuspected connection of every supplier and consumer is required. Rule 3 advocates direct and simple pathways for every product and service. Rule 4 advocates little developments done scientifically within the guidance of a teacher at the lowest realistic level (Spear and Bowen, 1999). Regarding the third category, lean is defined as combination of techniques and tools (Shah and Ward, 2003; Lasa *et al.*, 2008; Basu, 2009) intended to eliminate waste. Shah and Ward (2007) created ten distinct aspects to characterize lean production system, i.e., supplier feedback, just in time delivery by suppliers, supplier development, customer involvement, pull system, continuous flow, set up time reduction, total productive/preventive maintenance, statistical process control and employee involvement.

Operational performance: Operational performance is related to organization’s internal operation such as productivity, quality of product and customer satisfaction (Feng *et al.*, 2007; Nugraha and Indrawati, 2017; Kuo and Chen, 2015). It is typically assessed along with the dimension of percent returns (Rosenzweig *et al.*, 2003; Poirier and Quinn, 2004), percent defects (Frohlich and Westbrook, 2001), delivery speed (Buzzell and Ortmeier, 1995), production costs production lead time, inventory turns (Zhu and Karemer, 2002; Ranganathan *et al.*, 2004) and flexibility.

Firm performance: Conventionally, a firm performance has been observed and assessed in accounting words (Conant *et al.*, 1990; Jennings and Seaman, 1994; Kurniawati and MeilianaIntani, 2016; Ghalayini, 2016).

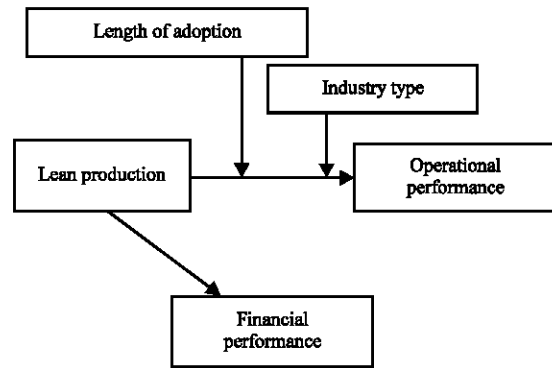


Fig. 1: The competing model

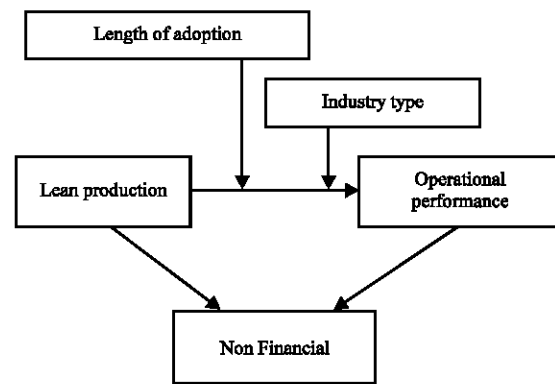


Fig. 2: The proposed theoretical model

However, a literature related to assessment of business performance (Kaplan and Norton, 2001; Lynch and Cross, 1991; Otley, 1999) stressed that employers are likely to locate relatively less importance on traditional financial performance’s measures such as return on investment, return on equity or net profits. This is consistent with Barros and Santos (2006) who explained that firm performance is a consequence from the ability to use resources and top management cares for overall result of both finance and non-finance performance. Generally speaking, the word performance results in the leading position of evaluations such as profit, cost and market share (Laitinen, 2002). Sink and Tuttle (1989) confirmed that performance should not be dealt barely as a financial perspective. Moreover, Li *et al.* (2009) proposed that performance can be measured by non-financial performance such as efficiency, growth, market share, profit, customer satisfaction (Fig. 1 and 2).

MATERIALS AND METHODS

Research model: The objective of this study is to investigate the relationships among lean production,

operational performance and firm performance; thereby, the study was conducted and accomplished by quantitative method using random sampling and snowball sampling from 629 current middle and top managers working in Thai manufacturing industry. The results were analyzed by descriptive statistics, confirmatory factor analysis and the structural equation modeling by using statistical software programs.

The study was conducted by means of questionnaires consisting of four parts. The first part is demographic information of respondents and information of the organizations. The second part is lean manufacturing which were created by Shah and Ward (2007). The latter two parts are the operational performance scale was taken from Rahman *et al.* and financial performance scale was developed from Griffith *et al.* (2006), Wiklund and Shepherd (2005) and Hung *et al.* (2010).

RESULTS AND DISCUSSION

The total 629 of 1860 questionnaires (response rate 33.82%) were obtained to do analysis. The majority of respondents were male (56.3%) of the age above 40 years old (32.6%), factory/production manager (39.1%), bachelor’s degree (75.8%), working in medium size company (36.9%), nonautomotive (60.9%) and company age above 15 years (46.6%).

Before conducting any statistical analysis, the rule of normal distribution of collected responses should be examined. The skewness and kurtosis values which evaluate the normal distribution, should vary from -3 to +3 (Carlo, 1997). The results presented that the skewness values vary from -0.853 to 0.263 and the kurtosis values vary from -1.851 to 2.380. Meanwhile, the Pearson’s bivariate correlations of all relationships were significant. Therefore, it could be summarized that the normal distribution and linearity principle were accepted.

Model fit testing: The Chi-square is important statistics; however, a statistical significance test is responsive to sample size which presents that when the large samples are applied, the Chi-square statistic nearly always denies the framework (Bentler and Bonnet, 1980; Joreskog and Sorbom, 1996). Therefore, several academicians mentioned that a framework could also be accepted if most of the fit indices report good evaluation results and only a few quantities of indices are less than the lowest threshold (Fornell and Larcker, 1981; Bagozzi and Yi, 1988). Although, the finding of Chi-square statistics of the proposed theoretical model showed significance at a 0.05 level, the left over results were higher than the

minimum criteria displayed in Table 1. Thus, it could be claimed that the structure of lean production, operational performance and financial performance were reasonable to illustrate the interrelationships among items and latent variables.

Hypothesis testing

Direct effect testing: The value of t-test depicted in Table 2 including the estimated value, Standard Error (SE), Critical Ratio (CR) and p-value, indicates that there is a significant positive relationship between lean production and operational performance, lean production and financial performance and operational performance and financial performance. Thus, it could be summarized that H₁-H₃ were supported.

Mediate effect testing: The competing model was to investigate the direct effect of lean manufacturing on operational performance and financial performance which is depicted in Fig. 1. Comparing the model fit statistics of the competing model and the proposed theoretical model which is presented in Table 1, these results confirmed that the model fit statistics of the proposed theoretical model is greater than the competing model. Thus, it could be asserted that the relationships among lean manufacturing, operational performance and financial performance are better described by an effect of lean production on financial performance through operational performance.

Regarding the competing model, the standardized direct effect between lean production and financial performance was 0.419. In contrast, the findings from the proposed theoretical model revealed that standardized direct effect between lean production and financial performance was 0.276 while the standardized indirect effect was 0.125 and standardized total effect was 0.400. Since, the standardized direct effect of the proposed theoretical model was less than that of the competing model it could be summarized that there is an effect of lean production on financial performance through operational performance.

Due to the greater model fit statistics and the low level of the standardized direct effect, it could be summarized that H₄ was supported (Table 3). Regarding the results in Table 4, the equations for the proposed theoretical model were conducted:

$$\widehat{\text{Operational Performance}} = 0.563 \text{ lean production} \quad (1)$$

$$\widehat{\text{Financial performance}} = 0.400 \text{ lean production} + 0.221 \text{ operational performance} \quad (2)$$

Table 1: Comparing model fit indexes between the competing model and the proposed theoretical model

Models	CMIN	df	CMIN/df	CFI	IFI	AGFI	NFI	TLI	RMSEA	Default model				p-values
										AIC	BCC	BIC	CAIC	
Competing	151.128	50	3.023	0.972	0.972	0.941	0.959	0.963	0.057	207.128	208.312	331.564	359.564	0.000
Proposed	134.573	49	2.746	0.976	0.976	0.945	0.963	0.968	0.053	192.573	159.928	321.543	350.453	0.000

Table 2: Hypotheses testing results of the proposed theoretical model

Hypotheses	Estimate	SE	CR	p-values
H ₁ : lean production→ operational performance	0.545	0.047	11.586	***
H ₂ : lean production→ financial production	0.389	0.080	4.849	***
H ₃ : operational performance→ financial production	0.323	0.081	4.006	***

***p<0.001 was at the significant level of 0.001

Table 3: Standardized direct, indirect and total effects among factors of the competing model

Productions	Standardized		
	Direct effect	Indirect effect	Total effect
Lean production→operational performance	0.574	0.000	0.574
Lean production→financial performance	0.419	0.000	0.419

Table 4: Standardized direct, indirect and total effects among factors of the proposed theoretical model

Productions	Standardized		
	Direct effect	Indirect effect	Total effect
Lean production→operational performance	0.563	0.000	0.563
H ₄ : Lean production→financial performance	0.276	0.125	0.400
Operational performance→ financial performance	0.221	0.000	0.221

Moderate effect testing: Considering the moderate effect of automotive and nonautomotive industry, the Chi-square of the unconstrained was 249.765 and degree of freedom was 98 whereas the Chi-square of the fully constrained was 270.217 and degree of freedom was 110. The difference of the Chi-square was 20.452 and degree of freedom was 12. The p-value was 0.059 which could be summarized that the model is not different across type of industry at 0.05 significant level. After checking each specific path, the results reported that industry has no moderate effect on the path from lean production and operational performance as well as the rest of all path levels. Thus, it can be concluded that H₅ and H₆ are rejected.

Considering the moderate effect of lean adoption <5 years comparing to more than 5 years, the Chi-square of the unconstrained was 200.461 and degree of freedom was 98 whereas the Chi-square of the fully constrained was 213.009 and degree of freedom was 110. The difference of the Chi-square was 12.548 and degree of freedom was 12. The p-value was 0.403 which could be confirmed that the model is not different across length of

Table 5: Summary of hypotheses testing of the proposed theoretical model

Hypotheses and its description	Results
H ₁ : there is a positive relationship between lean production and operational performance	Supported
H ₂ : there is a positive relationship between lean production and financial performance	Supported
H ₃ : there is a positive relationship between operational performance and financial performance	Supported
H ₄ : there is an effect of lean production on financial performance through operational performance	Supported
H ₅ : there is a moderate effect of type of industry on the relationship between lean production and operational performance	Rejected
H ₆ : there is a moderate effect of type of industry on the simultaneous relationships of proposed theoretical model	Rejected
H ₇ : there is a moderate effect of length of lean adoption on the relationship between lean production and operational performance	Rejected
H ₈ : there is a moderate effect of length of lean production on the simultaneous relationships of proposed theoretical model	Rejected

lean adoption at 0.05 significant level. After checking each specific path, the results reported that length of lean adoption has no moderate effect on the path from lean production and operational performance as well as the rest of all path levels. Thus, it can be concluded that H₇ and H₈ are denied (Table 5).

The finding fulfills the ambiguous knowledge on consequences of lean manufacturing by confirming most of previous studies' results, insisting that there is positive relationship between lean production and operational performance (Hallgren and Olhanger, 2009; Alsmadi *et al.*, 2012; Agus and Hajinoor, 2012) and there is positive effect of lean production on financial performance (Fullerton and Wempe, 2009; Hibadullah *et al.*, 2013; Jayaram *et al.*, 2008). Since, there are few studies investigating mediate or moderate effect of variables that influence the lean successful and its consequences, this study augments the scholarly comprehension by confirming that the lean manufacturing will bring about both efficient and effective operational performance such as higher level of productivity, quality, customer satisfaction, value offer to customer and lower level of cost reduction, defect rate, machine setup time and delivery time to customer which will finally result in superior financial performance such as higher level of return on asset, return on equity, profit, market share and sale growth.

Moreover, the results reported that the model is not different across automotive and nonautomotive industry which asserts the previous investigations such as that of

Womack *et al.* (1990), suggesting that manufacturing problems and technologies were universal problems. Thus, the application of lean is not limited to the automotive sector only but it has also found acceptance in a wide range of manufacturing industries operating under a unionized or a non-unionized environment in the US (Shah and Ward, 2003) or elsewhere (Anand and Kodali, 2008) and it is being applied in both large and small firms (White *et al.*, 1999).

Finally, the results reported that the model is not different across the length of lean adoption which is the contribution of this study due to 90.0% of respondents who responded that their company applied lean production for <5 years. In addition, the respondents whose company employed lean production more than 5 years proposed that although the lean production was implemented for a long time, it was unsuccessful due to no seriousness, no support and no attention from all employees, especially the top management.

CONCLUSION

This study fulfills the vague knowledge by confirming the relationships among lean manufacturing, operational performance and financial performance. In addition, this study augments the comprehension that lean manufacturing can be applied in any industry. Accomplished lean implementation requires serious and much attention from all members across company, suppliers, distributors and customers. Referring to the scarcity of lean manufacturing success at present time (Pay, 2006), it is likely to be a challenge for the future research to explore both antecedent, consequent and intervention factors which will result in superior understanding of the lean production notions and utilizations. Successful lean implementation will generate better financial outcomes and lower cost thanks to the willingness of all employees and efficient processes which lead to sustainable competitiveness.

LIMITATIONS

There are some expected potential limitations. Firstly, the effect of external factors which may involve lean production, operational performance and financial performance such as political issues, macroeconomics, microeconomics and economic crisis. Secondly, due to the study applying self-report and cross-sectional data, the summarizations could not only make causal extrapolations but also increase some concerns about common bias. Thus, a study in long term is required to offer greater definitive summarization. Thirdly, the results explain the

manufacturing firm's situations and activities which may not be corresponding with the service companies. Lastly, the results describe situations and activities of firms operating in Thailand which may not be compatible with overseas companies.

IMPLICATIONS

The findings provide some implications for the practitioners and entrepreneurs. The results show that lean manufacturing will result in high level of both operational and financial performance which is worth taking more attention. In addition, Thai managers tend to understand that lean manufacturing is suitable for only automotive industry. Nevertheless, the results confirmed that it can be applied for any manufacturing as well as any company size. Moreover, at present, there are many studies asserting that it can also be applied in service industry. Successful lean production requires serious cooperation and attentions of all employees across company, thus, managers should create the good two-way relationship, sharing, caring, bottom up communication and free-rein culture with their employees. Effective supply chain management is imperative by close communications and relations with suppliers, distributors and customers.

SUGGESTIONS

The results offer several implications for scholarly researchers. First, the future study would be to examine other potential independent and dependent factors of lean manufacturing practice. According to the fact, the relationship between a variety of independent factors and lean manufacturing practice incline to be more robust for leadership style, followership style, size of company, competition level and degree of technology and innovation. As a result, the future research would be to investigate the moderate and/or mediate influences of these factors on the relationship between independent variables and lean production. In addition, the future investigation might examine the magnitude to which interventions could create a lean manufacturing practice for leading higher organizational performance. Finally, the successful lean production required cooperation across all members of supply chain which take time; thus requiring longitudinal study.

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