*IOSR Journal of Engineering (IOSRJEN)*
*ISSN: 2250-3021 Volume 2, Issue 7(July 2012), PP 13-18*
*www.iosrjen.org*

# Lean Six Sigma Initiative: Business Engineering Practices and Performance in Malaysian Automotive Industry

Nurul Fadly Habidin[1], Sha'ri Mohd Yusof[2], Che Mohd Zulkifli Che Omar[1], Syed Ismail Syed Mohamad[3], Sharul Effendy Janudin[3], and Baharudin Omar[3]
[1](*Department of Management and Leadership, Universiti Pendidikan Sultan Idris, Malaysia)*
[2](*Department of Manufacturing and Industrial Engineering, Universiti Teknologi Malaysia, Malaysia)*
[3](*Department of Accounting, Universiti Pendidikan Sultan Idris, Malaysia)*

***ABSTRACT :*** *The automotive industry in various countries struggle to sustain a high degree of lean practice due to competitive market and customer pressure. Recently, Integration between lean and six sigma initiatives are increasingly implemented in the industry. The importance and relationship between lean practices and organizational performance has been highlighted in many studied. The purpose of this paper is to examine the relationship of Lean Six Sigma (LSS) practices and organizational performance in Malaysian automotive industries. A Conceptual model using Structural Equation Modeling (SEM) has been proposed. This model will be used to study the relationship between LSS practices and organizational performance in Malaysian automotive industries. Based on the proposed conceptual model and reviewed, research hypotheses are being developed. The paper concludes with suggest future research work.*

***Keywords*** *– Lean six sigma, quality initiatives, organizational performance, structural equation model, automotive.*

## I. INTRODUCTION

In a competitive market, firms apply many quality initiatives such as Total Quality Management (TQM), lean, and six sigma and so on. As a matter of fact, World Class Manufacturing (WCM) achieved global competitive advantage through the use of their manufacturing capabilities as strategic weapon and providing world class performance element like productivity, quality, safety, environment, delivery, morale, flexibility, and cost (Hayes and Clark, 1985; Nachiappan *et al.,* 2009). Recently, automotive companies are moving toward lower cost of production, cheaper price, Just in Time (JIT) deliveries, and elimination of waste in any aspect of its operations and finally produce high quality product and better service to customer compared to competitors. Lean six sigma is considered as an important catalyst in this context (Basu and Wright, 2003; Sharma, 2003; Arnheiter and Maleyeff, 2005; Pepper and Spedding, 2010) for continually seek better performance and in turn against competitive advantage. Lean six sigma (combining two most important improvements) for businesses and organization that focus on operational excellence for continually seek better improvement in customer satisfaction, cost, quality, process, and speed. Nonetheless, after more than 25 years Malaysian automotive has been established, the performance of national car maker, supply parts by local suppliers still receive criticism, complaints, and various suggested approach to improve their product quality, operation management, and customer satisfaction. As a result, in order to improve the quality of automotive industries, Malaysian government has supported various quality initiatives, strategy and automotive policy such as vendor development program (PVD), zero defect, strategy partnership, and National Automotive Policy (NAP).

Thus, to help the National Automotive Policy (NAP) achieves one of their objectives which is to develop high value-added manufacturing activities in niche areas, further research is essential. By implementing LSS practices, local automotive companies will and have eliminated waste in operation activities such as to reduce defect, to reduce lead time, and reduce variation process, and also improve quality product and good service for customer satisfaction.

## II. LITERATURE REVIEW

In the last several years, more lean article and researchers demonstrated interest in describing and measuring lean practices by integrating with other practices and also investigated the effect of integrated approaches between practice and firm performance. For example, Flynn *et al.,* (1995) studied the relationship between JIT, TQM practices, and performance in three US manufacturing firm (electronics, transportation component, and machinery industries). In addition they also developed a survey instrument to measure both JIT and TQM. The finding result showed that JIT and common infrastructure practices had a positive effect on performance but the TQM had no significant effect. On other hand, (McKone *et al.,* 2001; Cua *et al.,* 2001) found that JIT, Total Productive Maintenance (TPM), and TQM gave positive effect on performance.

In addition, a limited number of empirical studies suggested the implementation of integrated lean practices and six sigma practices. However, the first empirical paper found in Shah *et al.*, (2008) argue that some lean practices have greater commonality with six sigma compared other practices. Their focus was to investigate and conduct a comparative study on lean practices, six sigma implementation and firm performance.

### *2.1 Lean Six Sigma Constructs*

Many studies have investigated the composition of lean initiatives, the common barriers to lean implementation and critical factor for the success of lean and six sigma (Sakakibara *et al.*, 1993; Flynn *et al.*, 1995; Koufteros *et al.*, 1998; Boyer, 1996; Cua *et al.*, 2001; Shah and Ward, 2003; Li *et al*., 2005; On, 2006; Zu *et al.*, 2008). Although the results of these studies are different that actually has discovered a common set of practices that is required for the success of LSS implementation.

In the interest of generating a distinguished construct, an analysis on numerous proposed construct is carried out. Table 1 shows a list of similar practices proposed by different authors for each generic construct. Then every construct is analyzed whether it is different or similar to the previously analyzed construct.

**Table 1:** Construct proposed from literature

| Constructs | Related constructs |
|---|---|
| Leadership | Quality Leadership (Flynn *et al.*, 1995; Boyer, 1996), committed leadership (Cua *et al*., 2001), and leadership, (On, 2006) |
| Structured Improvement Procedure | Methodology tool and application (On, 2006), and structured improvement procedure, (Zu *et al.*, 2008) |
| Quality information and analysis | Statistical process control (Flynn *et al.*, 1995, Shah and Ward, 2003), quality improvement efforts (Sakakibara *et al.*, 1993), and management by data (On, 2006) |
| Supplier Relationship | Strategic supplier partnership (Li *et al*., 2005), and supplier development (Shah and Ward, 2003) |
| Just in Time (JIT) | Just-in-time (Sakakibara *et al.*, 1993), and time base manufacturing (Koufteros *et al*., 1998) |
| Customer focus | Customer relationship (Li *et al*., 2005), customer focus (On, 2006), and customer involvement (Shah and Ward, 2003) |
| Focus in metrics | Result (On, 2006), and focus in metrics (Zu *et al.*, 2008) |

### *2.2 Organizational Performance Measures*

Performance measurement is common in any firm, be it for measuring on financial aspect, non-financial aspect, or both financial and non-financial measurement. Based on that, Kaplan and Norton (1992) proposed multiple performance measure in balanced scorecard approach. These comprehensive measures of performance are based on four perspectives: financial, customer, business process/operation, and innovation/learning growth. Kanji (2002), suggested four key areas for measuring organizational performance, namely: to maximize stakeholder value, to achieve process excellence, to improve organizational learning, and to satisfy the customers. These four key areas are also consistent with the four perspective of Balanced Scorecard as documented by Kaplan and Norton (1996a).

According to Ittner and Larcker (1998), managers need to focus on both financial and non-financial measures to achieve organizational goals. The balance comes from tracking not only financial performance measure such as operating income, sales growth and sales revenue, but also non-financial ones as well. This is because non-financial measures are likely to facilitate organizational decisions and actions that support strategies based on the stakeholders need (Hoque and James, 2000). It has also been suggested (Kaplan and Norton, 1996a, 2001) that non financial performance measure helps managers to assess changes in the business environments, determine and evaluate progress towards the firm's goal, and affirm achievement of business performance. Table 2 shows the proposed measurement item organizational performance which are: financial, customer, internal business process, and innovation and learning growth.

**Table 2:** Organizational performance measures

| Organizational Performance measure | Items | References |
|---|---|---|
| Financial | Increased operating income, Increased sales growth, Increased return-on-investment, Increased cash flow, Increased sales revenue, Reduced manufacturing cost, Increased economic value added, and Increased capital efficiency | Kaplan and Norton, 1996a; Hoque *et al.*, 2001; Mahapatra and Mohanty, 2007; Jusoh and Parnell, 2008; Bhasin, 2008; and Eker and Pala, 2008 |
| Customer | Increased market share, Increased customer satisfaction, Improved customer retention rate, Reduced the number of customer complaints, Reduced the number of warranty claims, Reduced the number of warranty claims, Reduced the number of shipments returned due to poor quality, and Reduced the number of overdue deliveries | |
| Internal Business Process | Improved material efficiency variance, Improved the ratio of good output to total output at each production process, Improved manufacturing lead time, Improvement of workers efficiency, Improved quality of the purchase item, Improvement of plant utilization, Improved relation with vendor, Reduced the rate of material scrap loss, Reduced the defect rate, Reduced setup and changeover time, Reduced cycle time, Reduction in inventory, Reduced redesign plant layout, and Reduction of forecasting errors | |
| Innovation and Learning Growth | Improved the number of new patents, Improved the number of new product launches, Improved quality of professional/technical development, Improved quality of leadership development, Improved new market development, Improved new technology development, Increased the level of Employee satisfaction, Increased employee training, and Reduced the level of Health and safety per employees e.g accident, absenteeism, and labour turnover | |

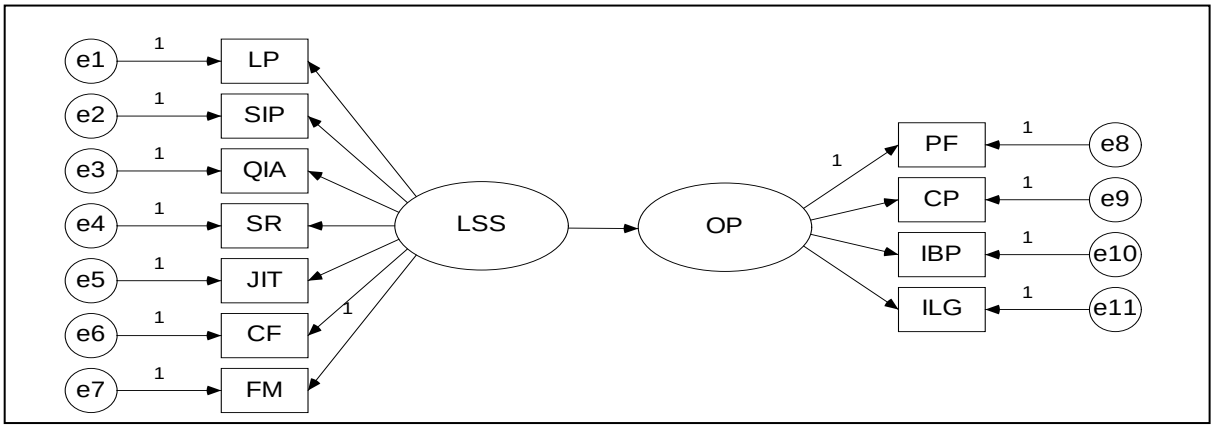
## III. PROPOSED STRUCTURAL ANALYSIS MODEL BETWEEN LSS PRACTICES AND ORGANIZATIONAL PERFORMANCE MEASURES

The critical issues in lean and six sigma studies by previous researchers there is a need to integrate between lean, six sigma, and organizational performance. Shah and Ward (2003) used 22 individual lean practices and classification of lean practices as four bundles (1) JIT; (2) TQM; (3) TPM; (4) HRM. Thus, they also applied the same approach to integrate lean practice, six sigma implementation and firm performance (Shah *et al.*, 2008). In addition, there are also underlying 10 lean factors (Kannan and Tan, 2005) namely: supplier feedback, JIT deliveries by suppliers, supplier development, customer involvement, pull production system, employee involvement, continuous flow, setup time, SPC, and TPM.

On the other hand, Zu *et al.*, (2008) in their empirical studies explored the integration between quality management practices, six sigma and performance. They also developed a survey instrument which consisted of three out of four element suggested by (Schroeder *et al.*, 2008). They are role structure, structure improvement procedures, and focus on metrics.

Later on, organizational performance from Kaplan and Norton (1992, 1996a, b) followed suit. However, organizational performance was developed based on review of empirical study on lean and six sigma performance measure. This balanced scorecard provided a useful guidance for manufacturing, especially in automotive industry to evaluate and measure of lean in balanced scorecard way. The different lean performance metric was categorized under four perspectives, and this assisted the industry to evaluate lean and six sigma performance in balanced scorecard way from the angle of financial and non financial measurement perspectives (financial, customer, internal business process, and innovation and learning growth).

Based on comprehensive review of previous study, a conceptual model using Structural Equation Modeling (SEM) has as presented in Figure 1. SEM is method of data analysis method which is increasingly used in operation management empirical studies (Shah and Goldstein 2006). SEM not only estimates multiple interrelated relationships but also has the ability to incorporate latent constructs into an analysis. A latent construct cannot be measured directly but can be approximated by observed or measured variable. The measured variables are obtained from respondents in response to questions of a questionnaire. The research model aims at analyzing the impact of the relationship between LSS and organizational performance for Malaysian automotive industries.




LATENT VARIABLE**:** LSS= Lean Six Sigma, OP = Organizational Performance
OBSERVED VARIABLE: Leadership (LP), structured improvement procedures (SIP), quality information and analysis (QIA), supplier relationship (SR), just-in-time (JIT), customer focus (CF), focus in metric (FM), Financial (FP), customer (CP), internal business process (IBP), and innovation and learning growth (ILG)

**Figure 1**
A proposed structural relationship research model

## IV. RESEARCH HYPOTHESES

Most of popular lean improvement articles unveil the relationship between lean/six sigma practices and performance. However, according to Ittner and Larcker (1998), managers need to focus on both financial and non-financial measures to achieve organizational goals. Having a lean six sigma implementation, it realizes the improvement in the operation performance (such as scrap, rework, accuracy, inventory, machine line downtime, order process time, setup time, lead time, cost, defect, delivery, and productivity), customer metric (customer satisfaction, customer complaint, customer retention, warranty claim, and product recall) financial metrics (sales, market share, unit of cost manufacturing, operating income, profitability, and return on asset) and innovation metric (employee complaint, employee performance) impact on organization performance (Jayaram and Vickery, 1998; Fullerton and McWatters, 2001; Lee, 2002; Shah and Ward, 2003; and Nahm *et al.*, 2004; Challis *et al.*, 2005; and Hayya and He, 2002; Hsia, 2006; Narasimhan *et al.*, 2006; Matsui, 2007, and Pont *et al.*, 2008).

Zu *et al.,* (2008) report that six sigma practices is integrated with seven traditional quality management practices to affect quality management and business performance. The results ffindsthat six sigma element contributes to higher performance improvement. Other study by Shah *et al.,* (2008) explores the relationship between lean practices, six sigma, and firm performance. The finding also exhibits that the group of plants which implement lean and six sigma have higher performance than non implementers. However, Fullerton and Wempe (2009) in their study in US manufacturing come out with two sets of result. Firstly, firm lean practice has varied direct effect on financial performance. Secondly, the indirect impact of lean practices on financial manufacturing performance via mediating effect of non-financial manufacturing performance signals a significant evidence. In this study, the impact of lean six sigma implementation on the organizational performance will be investigated. A hypothesis regarding the relationship between TQM and organizational performance for both countries is formulated as follow.

*H1: There is a positive and direct significant relationship between LSS implementation and organizational performance of Malaysian automotive industry*

## V. CONCLUSION

Recently, many researchers and practitioners look for implementation of LSS as their organization strategy for quality and performance improvement. However, no previous study had tried to investigate the critical success factors of LSS and the relationship between LSS practice and organizational performance, especially in automotive industry. Empirical study in Malaysian automotive industry will be carried out by using the proposed conceptual model.

## VI. Acknowledgements

The researchers would like to acknowledge the Ministry of Higher Education (MOHE) for the financial funding of this research thought Fundamental Research Grant Scheme (FRGS) and Research Management Centre (RMC), UPSI for Research University Grant (RUG).

## REFERENCES

[1] Arnheiter, E., and Maleyeff, J. (2005). The integration of lean management and six sigma. *The TQM Magazine*, 17 (1) 5-18.
[2] Basu, R., and Wright, J. N. (2003). *Quality Beyond Six Sigma*. Butterworth Heinemann, Oxford, 2003.
[3] Bhasin, S. (2008). Lean and performance measurement. *Journal of Manufacturing Technology Management*, 19 (5), 670-684.
[4] Boyer, K. K. (1996). An assessment of managerial commitment to lean production. *International Journal of Operation Management*. 16 (9), 48-59.
[5] Challis, D., Samson, D., and Lawson, B. (2005). Impact of technological, organizational and human resource investments on employee and manufacturing performance: Australian and New Zealand evidence. *International Journal of Production Research*, 43 (1), 81-107.
[6] Cua, K.O., McKone, K.E., and Schroeder, R.G. 2001. Relationship between implementation of TQM, JIT, and TPM and manufacturing performance. *Journal of Operations Management*. 19: 675-694.
[7] Eker, M., and Pala, F. (2008). The effect of competition, just in time and total quality management on the use of multiple performance measures: an empirical study. *Journal of Economic and Social Research*, 10 (1), 35-72
[8] Flynn, B. B., Sakakibara, S., and Schroeder, R. G. (1995). Relationship between JIT and TQM: practice and performance. *Academy of Management Journal*. 38 (5), 1325-1360.
[9] Fullerton, R. R., and McWatters, C. S., (2001). The production performance benefits from JIT implementation. *Journal of Operation Management*, 19, 81-96.
[10] Fullerton, R. R. and Wempe, W. F. (2009). Lean manufacturing, non-financial performance measures, and financial performance. *International Journal of Operations and Production Management*, 29 (3), 214-240.
[11] Hayes, R. H., and Clark, K.B. (1985). Explaining observed productivity differentials between plants: implication for operation research. *Interfaces*. 15 (6), 3-14.
[12] Hayya, J. C., and He, X (2002). The impact of just-in-time production on food quality. *Total Quality Management*, 13 (5), 651-670.
[13] Hoque, Z, and James, W. (2000). Linking the balanced scorecard measures to size and market factors: impact on organizational performance. *Journal of Management Accounting Research*, 12, 1-17.
[14] Hoque, Z., Mia, L., and Alam, M. (2001). Market competition, computer aided manufacturing and use of multiple performance measures: an empirical study. *British Accounting Review*, 33, 23-45.
[15] Hsia, P. S. (2006). *The effect of Six Sigma implementation practices on business performance*. Master Thesis, Graduate School of Management, Tatung University, Taipei, Taiwan, Republic of China.
[16] Ittner, C. D., and Larcker, D. F. (1998). Innovations in performance measurement: trends and research implications. *Journal of Management Accounting Research*, 10, 205-238.
[17] Jayaram, J., and Vickery, S. K., "Supply-based strategies, human resource initiatives, procurement leadtime, and firm performance. *International Journal of Purchasing and Materials Management*, Vol. 34, No.1, pp12-23, 1998.
[18] Jusoh, R., and Parnell, J. A. (2008). Competitive strategy and Performance measurement in the Malaysia context: an exploratory study. *Management Decision*, 46 (1), 5-31.
[19] Kannan, V. R., and Tan, K. C. (2005). Just in time, total quality management, and supply chain management: understanding their linkages and impact on business performance. *Omega*. 33: 153-162.
[20] Kanji, G. K. (2002). *Measuring business excellence*. Routledge Advances inManagement and Business Studies. London, Routledge.
[21] Kaplan, R. S., and Norton, D. P. (1992). The balanced scorecard-measure that drive performance. *Harvard Business Review*, January-February, 71-79.
[22] Kaplan, R. S., and Norton, D. P., (1996a). *The balanced scorecard-translating strategy into action*, Boston: Harvard Business Scholl Press.
[23] Kaplan, R. S., and Norton, D. P. Using the balanced scorecard as a strategic management system. *Harvard Business Review, January-February, 71 (1)*, 1996b, 75-85.
[24] Koufteros, X. A., and Vonderembse, M. A., and Doll, W. J. (1998). Developing measures of time based manufacturing. *Journal of Operations Management*. 16 (1), 21-41.
[25] Lee, K-L. (2002). Critical success factor of six sigma implementation and the impact on operations performance. Doctorate Engineering Dissertation, Cleveland State University.
[26] Li, S., Rao, S. S., Ragu-Nathan, T. S., and Ragu-Nathan, B. (2005). Development and validation of a measurement instrument for studying supply chain management practices. *Journal of Operations management*. 23, 618-641.
[27] Mahapatra, S. S., and Mohanty, S. R. (2007). Lean manufacturing in continuous process industrial research. *Journal of Scientific and Industrial Research*, 66, January, 19-27.
[28] Matsui, Y. (2007). An empirical analysis of just-in-time production in Japanese manufacturing companies. *International Journal Production Economics*, 108, 153-164.
[29] McKone, K.E., Schroeder, R.G., and Cua, K.O. (2001). The impact of total productive maintenance practices on manufacturing performance. *Journal of Operations Management*. 19, 39-58.
[30] Nachiappan, R. M., Anatharaman, N., and Muthukumar, N. (2009). Integrated approach to total productive lean six sigma (TLSS) implementation in a manufacturing industry. *The Icfai University Journal of Operation Management*. 8 (2), 14-35.
[31] Nahm, A. Y., Vonderembse, M. A., and Koufteros, X. A. (2004).The impact of organizational culture on time-based manufacturing and performance. *Decision Sciences*, 35, (4), 579-607.
[32] Narasimhan, R., Swink, M., and Kim, S. W. (2006). Disentangling leanness and agility: an empirical investigation. *Journal of Operation Management*, 24(5), 440-457.
[33] On, C. C. (2006). *The development and application of six sigma implementation model for HK/China manufacturing companies*. Thesis Engineering Doctorate, City University of Hong Kong.
[34] Pepper, M. P. J., and Spedding, T. A. (2010). The evolution of lean six sigma. *International Journal of quality and reliability management*. 27 (2): 138-155.
[35] Pont, G. D., Furlan, A., and Vinelli, A. (2008). Interrelationships among lean bundles and their effects on operational performance. *Operation Management Research*, 1, 150-158.
[36] Sakakibara, S., Flynn, B. B., and Schroeder, R. G. (1993). A framework and measurement instrument for just-in-tme manufacturing. *Production and Operations Management*. 2 (3), 177-194.

[37] Schroeder, R. S., Linderman, K., Liedtke, C., and Choo, A. S. (2008). Six sigma: definition and underlying theory. *Journal of Operations Management*. 26, 536-554.
[38] Shah, R., and Ward, P. T. (2003). Lean manufacturing: context, practice bundles, and performance. *Journal of Operation Management*. 21, 129-149.
[39] Shah, R. and Goldstein, S. M. (2006). Use of structural equation model in operations management research: Looking back and Forward. *Journal of Operation Management*, 24, 148-169.
[40] Shah, R., Chandrasekaran, A., and Linderman, K. (2008). In pursuit of implementation patterns: the context of lean and six sigma. *International Journal of Production Research.* 46 (23), 6679-6699.
[41] Sharma, U. (2003). Implementing lean principles with six sigma advantages: How a battery company realized significant improvements. *Journal of Organizational Excellence*, 22 (3), 43-52.
[42] Zu, X., Fredenhall, L. D., and Douglas, T. (2008). The evolving theory of quality management: the role of six sigma. *Journal of Operation Management*. 26, 630-650.