Lean Manufacturing Practices and Environmental Performance in Malaysian Automotive Industry

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Abstract

Toyota Production System (TPS) a systematic approach to identify and eliminate waste activities through continuous improvement and understand the principles of lean such as identification of value, elimination of waste and generation of flow (of value to the customer). This paper explores between lean manufacturing practices (supplier management, employee involvement, just in time, customer focus and statistical process control to monitor quality) and environmental performance outcomes (operational and innovation performances). The purpose of this study is to propose structural relationship lean manufacturing practices and environmental performance model for Malaysia automotive industries. The conceptual model using Structural Equation Modeling (SEM) has been proposed. Base on the proposed conceptual model and reviewed, research hypotheses are being develop, the paper culminates with suggested future research.

Keywords: Lean manufacturing, Environmental performance, Performance measurement, Toyota Production System automotive Industry
1. Introduction

The automotive industry in 21st century has forced most of the leaders in several sectors to implement more competitive manufacturing system. Compared with other industries in the manufacturing sector in Malaysia, the global industry has been identified to improve the industrialization process so that Malaysia can be a developed nation by 2020. Under the National Automotive Policy (NAP), to assist the transformation and integration of the local automotive industry optimally into the regional and global industrial network an increasingly liberalized and competitive.

Lean Manufacturing (LM) is a unified, comprehensive set of philosophies, rules, guidelines, tools, and techniques for improving and optimizing discrete processes. While lean was created in large volume, repetitive manufacturing for the automotive industry sector, lean principles and benefits apply to all processes such as health care and service.

LM is defined as an assembly-line manufacturing methodology developed originally for Toyota and the manufacture of automobiles. It is also commonly referred to as the Toyota Production System (TPS). Its aim is to get the right things to the right place at the right time, also to increase efficiency and decrease waste by receiving goods only as they are needed in the production process. The principles of lean manufacturing were developed by Taiichi Ohno, a Toyota engineer. In addition, principles allow the company to meet demand, reduce inventory, maximize the use of multi-skilled workers, flatten the management structure and focus resources where needed (Chen and Taylor, 2009).

LM is one of the initiatives projects have been trying to adopt in order to become more profitable and competitive in the global marketplace. Besides that, Prakash and Kumar, (2011) pointed out that LM processes are being used predominantly in the automotive industry such as TPS have since built their reputation as quality leaders and boast one of the fastest growing market shares in the automotive industry. Thus, these manufactures started using various tools and increase practices identified as key elements of lean approach such as Just-in-Time (JIT), kanban, setup time reduction, Total Productive Maintenance (TPM), Production cells, Employee Involvement (EI), Quality circles etc.

Lean concepts on the improvements in the entire business process as opposed to incremental improvements. It is the business process system that can significantly improve a company’s profitability. Besides that, in the globalization of market, the manufacturing performance balance comes from tracking not only financial performance measure such as operating income, sales growth and sales revenue, but 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 (1992; 1996a, 1996b) that non financial performance measure helps manager to assess changes in the business environments, determines and evaluates progress towards the firm’s goal, and a firm achievement of business performance.
2. Literature Review

2.1 Lean Manufacturing Practices (LMP)

LM is one of the initiatives that many major manufacturing plants in ASEAN, especially in Malaysia have been implement in order to remain competitive in an increasingly competition and globalization. Lee, (2008) presented a report about the automotive industry worldwide likewise face increasing pressures in the environmental arena. One of the best ways for achieving improvement in environmental performance, as well as to maintain the product quality and cost goals at the plant level, is unique partnerships with producers.

In addition, Shah and Ward, 2003 noted that LM represents a multifaceted concept that may be grouped together as distinct bundles of organizational practices. A list of bundles of lean practices includes Total Quality Management (TQM), TPM, JIT and shop floor involvement, pull, flow, low setup, controlled processes, and involved employees. LMP enhance manufacturing productivity by reducing setup times and work in process inventory improving throughput times, and thus improve environmental performance (Al Asyraf et al., 2012).

Definitions of the construct of LMP incorporated in Table 1.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supplier Management</td>
<td>Suppliers are important factors for the business success of the buying firm because they contribute, among others, to its product quality, flexibility, and costs. In order to being able to fully exploit the potential of supply market, it is necessary for a buying firm to handle its suppliers (Akamp and Muller, 2012).</td>
</tr>
<tr>
<td>Employee Involvement</td>
<td>Employees must be involved if they are to follow the need for creativity and if they are to be committed to changing their behaviour at work, in new and improved ways (Kuye and Sulaimon, 2011).</td>
</tr>
<tr>
<td>Just in time</td>
<td>Production strategy that strives to achieve excellence in manufacturing by reducing setup times and in-house lot sizes through the use of group technology for innovation, cross-training of employees, and sound preventive maintenance (Chong et al., 2001).</td>
</tr>
<tr>
<td>Customer Focus</td>
<td>Customer focus practices involve the establishment of links between customer satisfaction and their needs and internal processes (Sousa, 2003).</td>
</tr>
<tr>
<td>Statistical Process Control to monitor quality</td>
<td>SPC is a powerful technique for monitoring, managing, analyzing and improving process performance by statistical methods (Chen et al, 2008).</td>
</tr>
</tbody>
</table>

Based on the current definitions above, LM is a business improvement philosophy that has
developed over many years such as lean manufacturing tools, it is a method to better focus in business on the true needs of the customer to help eliminate waste from being built into system. A summary of LM practice benefits is given in Table 2.

Table 2. Benefit of LM practices

<table>
<thead>
<tr>
<th>Item</th>
<th>Author</th>
<th>Benefit</th>
</tr>
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</table>
| Employee Involvement     | Kuye and Sulaimon, 2011         | • Improved employee’s morale or job satisfaction and enhances productive efficiency;  
                              |                                  | • Provides employees the opportunity to use their private information; and |
|                          |                                 | • Through employee involvement, resources required to monitor employee compliance (e.g., supervision and work rules) can be minimized, hence reducing costs |
| Just in Time             | Chong et al., 2001              | • Reduced operating time;                                               |
|                          |                                 | • Decreased unit cost; and                                              |
|                          |                                 | • Improved labor productivity                                           |
|                          | Yasin et al., 1997              | • Improved communication internally and externally;                     |
|                          |                                 | • JIT tends to foster organizational discipline and managerial involvement; |
|                          |                                 | • Enhancing customer satisfaction                                        |
| Statistical Process Control | Chen et al., 2008             | • Increase efficiency and reduce resistance;                           |
|                          |                                 | • Reliable measurement system; and                                      |
|                          |                                 | • Establishing coordination and operation of the cross functional group  |
| Supplier Management      | Shin et al., 2000 and Prajogo et al., 2012 | • Long-term relationship with supplier;                                |
|                          |                                 | • Supplier involvement in the product development process;             |
|                          |                                 | • Reduced number of suppliers; and                                      |
|                          |                                 | • A quality focus where quality performance is the number one priority in selecting suppliers |
| Customer Focus           | Hongyu et al., 2006             | • Acquire information about the customers in large or medium sized marketplaces; |
|                          |                                 | • High quality service; and                                             |
|                          |                                 | • To obtain a quantified data to assess the employees performance and efficiency at work |

2.2 The Relationship between LMP and EP

Jusoh et al., (2008) investigated the performance measurement that gave effect on performance of Malaysian manufacturing firm. In this study, they used 29 performance measure item taken from Hoque et al., (2001) which was originally adopted from Kaplan and
Norton (1992) and developed nine items which were self constructed from literature. The finding result found that firm performance was positively affected from the overall performance measure usage. They also argued that when firms applied financial performance measures alone it was not sufficient to measure organizational performance.

Study by Yang et al., 2011 suggest that prior lean manufacturing experiences are positively related to environmental management practices. Improved environmental performance may benefit firms with respect to their consumers such as customer firm identification, customer satisfaction and loyalty leading to improved company image. Therefore, the relationship of lean manufacturing and environmental management practices become synergistic in terms of their focus on eliminate waste and inefficiency.

Beside that, Shah and Ward, (2003) pointed out that contextual factor have been suggested as possible obstructions to implementing lean production systems. Specifically, four bundles in examining the relationship between implementation and operational performance because interested in evaluating the synergistic effects of implementation of all complementary facets of lean such as JIT, TPM, TQM and Human Resource Management (HRM).

However, in different perspective, evidence of positive effects of lean manufacturing on innovation performance is presented by Chen and Taylor 2009, this study highlight that lean organizations to instill creativity and improve innovation capability. Techniques and strategies for an organization to achieve balance between successful lean practices and continuous product innovation will also be presented. Ideologies that appeared prior to it, including TQM and JIT production. An organization that effectively accommodates both lean and innovation will benefit the most and be competitive in the long term. A research finding of LM performance is given in Table 3.
Table 3. The research finding on Lean Manufacturing performance

<table>
<thead>
<tr>
<th>Elements</th>
<th>Authors</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental</td>
<td>Loureiro <em>et al.</em>, (2012)</td>
<td>• These consumers valued environmental performance much more than activities related to labor practices and community development; and • Reducing costs and increasing productivity and also increasingly consumer satisfaction</td>
</tr>
<tr>
<td></td>
<td>Yang <em>et al.</em>, (2011)</td>
<td>• Enhanced environmental performance; and • Reduces the negative impact of environmental management practices on market and financial performance</td>
</tr>
<tr>
<td>Operational</td>
<td>Prajogo, (2012)</td>
<td>• Increase long-term relationship; and • Improve supplier assessment and logistic integration</td>
</tr>
<tr>
<td></td>
<td>Machuca <em>et al.</em>, (2011)</td>
<td>• Manufacturing strategies play a fundamental role in the assessment of new technologies; and • Increase in the use of technology in manufacturing plant</td>
</tr>
<tr>
<td></td>
<td>Jabbour, (2012)</td>
<td>• Environmental issue tends to influence Operational Performance (OP) in a positive; • Reduction in production costs; and • Improved organization of the productive environment</td>
</tr>
<tr>
<td>Innovation</td>
<td>Brio and Junquera, (2003)</td>
<td>• Leadership style; and • Increase size on the company’s competitive activity (innovative activity)</td>
</tr>
<tr>
<td></td>
<td>Cordero, (2005)</td>
<td>• Motivate employee; and • Increase financial rewards</td>
</tr>
</tbody>
</table>

2.3 Hypotheses Development

Figure 1 showed research framework that represent how LMP and environmental performances are related. In brief, lean manufacturing implementation (e.g., Supplier Management, Employee Involvement, Just in time, Customer Focus and Statistical Process Control to monitor quality) assist organizations to improve environmental performance. Thus, we hypothesize,

H$_1$: There is a positive and direct significant relationship between LMP and environmental performance in Malaysian automotive Industry.
3. A Proposed Research Model

This paper proposed a conceptual model has been used to present the relationship between LMP and EP as presented in Figure 1. This proposed model has adopted the conceptual proposed by Yang et al. (2011). However, some amendments especially on LMP and EP constructs have been made.

![Diagram of A Proposed Conceptual Model for SME Framework](image)

*Note: LMP= Lean Manufacturing Practices, SM= Supplier Management, EI= Employee Involvement, JIT= Just in Time, CF= Customer Focus, SPC= Statistical Process Control, EP= Environmental Performance, OP= Operational Performance, IP= Innovation Performance

Figure 1. A Proposed Conceptual Model for SME Framework

4. Methodology

In this study, sampling method by using structured questionnaire. A survey is considered as the most economical among methods available for data collection due to its ability in performing efficient data collection (Moser and Kalton, 1971). In general, a survey typed questionnaire approach is relatively low cost of money, time saving, and simple approach. Moreover, by using survey methods, it can clarify the question the survey respondents and recording their responses to be used as data for analysis (Chang, 2002). Therefore it had been used by the authors.

The population of this study comprised in Malaysian automotive industry. Questionnaires will distribute to respondents from the listing of automotive industry obtained from Malaysian Automotive Component Parts Association (MACPMA), Proton Vendors Association (PVA), and Kelab Vendor Perodua. To analyze the data, two statistical techniques were adopted.

The statistical Package for the Social Sciences (SPSS) version 17 was used to analyze the
preliminary data and provide descriptive analyses about thesis sample such as means, standard deviations, and frequencies. SEM using AMOS 6.0 will use to test the measurement model.

Structural Equation Modeling (SEM) techniques was utilize to perform the require statistical analysis of the data from the survey. Exploratory factor analysis, reliability analysis and confirmatory factor analysis to test for construct validity, reliability, and measurements loading were performed. Having analyzed the measurement model, the structural model was then tested and confirmed.

5. Conclusion

On the whole, the aim of this paper is to explore the extent of LMP in Malaysian automotive manufacturing industry. The main contribution of this paper was to persuade managers to take an attention on the relationship between LMP and environmental performance. In general, LM is an arrangement of techniques and activities for running a production industries or service operation. In addition, they have the same core principle: the elimination of all non value adding activities and waste from the business. Hence, the top employee should understand and emphasis the importance to overcome this resistance for the successful implementation of lean manufacturing tool in their firms.

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References


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