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The Development and Validation of Green Lean Six Sigma Performance Improvement Tool (LSSPI) for Malaysian Automotive Industry

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ABSTRACT

The aim of this study is to develop a model and tool that incorporates Lean Six Sigma (LSS) implementation, Strategic Control System (SCS) and Organizational Performance (OP) in Malaysia automotive industries. 252 sets of questionnaire were successfully collected that brought to 64.3% response rate. Structural Equation Modeling (SEM) technique was adopted. From the findings of the survey, it was shown that strategic control system did assist in improving organizational performance when coupled with LSS. Analytic Hierarchy Process (AHP) methodology was used in developing a tool of Lean Six Sigma Performance Improvement (LSSPI) to measure the performance of automotive companies. This tool was developed by using a system based on Excel. Six case studies were prepared to validate this tool. The result of these case studies suggested that this tool was timely and suitable to determine organizational performance of automotive companies.

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INTRODUCTION

The question is whether measurements on price, quality and delivery are the only factors that portray the overall performance of the automotive suppliers? What about the other performance measurement such as customer, internal business process and innovation strategic factors that also play an important role in improving performance? This question gives the impression that there an urgency for a balanced comprehensive method of performance measurement on the suppliers evaluation process which is not only focusing on the traditional way but also integrating the quality initiative, strategic control and OP. In addition, based on the recommendation and the gap of the studies, it is essential to integrate the three strategic factors for the evaluation of suppliers. It is also a question of how to integrate the Lean Six Sigma (LSS), Strategic Control Systems (SCS), and Organizational Performance (OP) measures? In relation to the question of the strategic factor (LSS, SCS, and OP) measures should be based on a comprehensive strategic business system, rather than a comprehensive set of practices or component processes (Habidin and Yusof, 2012; Habidin and Yusof 2013). This is because the business system must be designed in line with the overall system perspective. Consequently, the need for more quantitative and qualitative research study to be conducted is apparent such as developing models and quality tools to create strategic business quality as aforementioned. With this study, it is hoped to help in improving the understanding, control and implementation of LSS, SCS, and OP measures among academicians and practitioners in the automotive industry.

Coinciding with this, this study is not only limited to providing structural relationship between the LSS model, SCS, and OP, but also to develop a tool that serves as a structured guideline for the implementation and assist in decision making process of evaluating and measuring performance. As such, it is not an easy decision to determine the best suppliers among the many suppliers who have registered. Therefore, it is better and easier if the organization develops a systematic tool to assist decision making process in evaluating suppliers. In

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regards to that, this study focuses on techniques to integrate Analytical Hierarchy Process (AHP) and Excel based system into the overall process of decision making to the organization by providing a simple, friendly, more structured and systematic approach. Thus, a new tool is developed and serves to assist in strategic decision making process for evaluating suppliers which is known as Lean Six Sigma Performance Improvement (LSSPI) tool.

In order to ensure acceptance and suitability for the practice, LSSPI should be firstly authenticated by several experts from the automotive industry. Through this tool, organizations can enhance a better understanding in the management, development and improvement of the suppliers so that they are able to identify the strengths and weaknesses to make improvements to their suppliers. Finally, the developed LSSPI tool creates a strategic business system involving business process excellence, strategic implementation and focuses enhancing the performance and at the same time, it could also serve as a platform to the automotive industry in enhancing the LSS Initiatives, SCS and OP measures.

In the recent time, lean integrated with six sigma initiatives has been a focused agenda among the academicians and practitioners in the field of quality and continuous improvement in which this initiative combines the advantages of each to help the organization to achieve customer satisfaction, higher competitive advantage, increase the activity of continuous improvement and also gain business and operational excellence. This is because, lean strategy not only plays an important role in eliminating waste and non-value added activities throughout the organization, but also through six sigma statistical tools and techniques, they increase the organization's ability to use and to analyze data in business processes and performance. Furthermore, according to O'Rourke (2005) many companies have recognized that a strong synergy is produced when these two initiatives are combined together in an effort to ensure the successful implementation of quality initiatives in an organization.

In addition to that, it is necessary for organizations to understand and measure their performance improvement in LSS perspective. Performance measurement is to help organizations identify their strengths and weaknesses to be improved. Unfortunately, it is very difficult to find empirical studies that have shown that there is a significant correlation between the LSS and OP. But recently, several empirical studies (Shah *et al.*, 2008; Zu *et al.*, 2008) have been marked as a catalyst and a starting point in the study of the relationship between LSS and the OP in the manufacturing industry. However, variables of these studies do not portray the formation of LSS as a complete set of initiatives in influencing the increase in OP. The lack of empirical evidence about the impact of LSS on the OP may be one of the main reasons of why the application of LSS in the automotive industry is still a subject of heated debate ever since.

To ensure the successful implementation of quality initiatives in enhancing OP, performance measurement as a whole should be designed in line with current business needs, quality initiatives program, capacity and development of new technology, increased global competition, and civilizing work towards continuous improvement. Thus, both financial and non-financial performance are required by the organization because the current business era requires not only quality initiatives as a business strategy but also as a business system that emphasizes aspects of financial, quality processes, customer satisfaction and innovation. Thus, the performance assessment of various financial and non-financial factors from the perspective of LSS is required in the automotive industry to help form strategic decisions on either the short or long term agendas.

Besides proposing a comprehensive performance measurement, Kaplan and Norton (2000) also states that more than 70% of organizations around the world failed to implement quality initiatives successfully. In facing this scenario, the implementation of a SCS is timely for the success of quality initiatives. This is important as it should be absorbed and practiced together to support the implementation of quality initiatives practices such as participation in continuous improvement, managing business processes and focusing on the customer.

The implementation of the LSS initiative is not an easy task and there are still challenges and obstacles to the organization, especially to newly established companies, due to less exposure and experience in managing quality initiatives, and likewise goes to Small and Medium-sized Enterprises (SMEs) companies. Therefore, to ensure the implementation of the LSS to be applied in various industries, it should be strategic, effective and not complex.

In line with this, there is a need for organizations to integrate initiatives between LSS and the Balanced Scorecard (BSC). BSC not only serves as a tool for performance measurement, but aligned with SCS organizations that directly translate organizational strategies into action oriented plans (Kaplan and Norton, 1996). BSC also provides useful guidance to the organization and industry, particularly to the automotive industry in evaluating and measuring the LSS performances in BSC way.

Reseach Methodology:

It starts with a research design, a discussion on the overall structure of the research methodology, and survey methodology. In the survey methodology section, a detailed explanation is provided on questionnaires development, expert validation, pilot study, population and sampling of the study, reliability, validity, and statistical analysis. Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) are also

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discussed in order to proceed on the discussion of the procedures of Structural Equation Model (SEM). Next this research presents the development of Lean Six Sigma Performance Improvement (LSSPI) Tool for the Malaysian Automotive Industry. This tool was developed by using the Analytic Hierarchy Process (AHP) methodology, which involves building a hierarchy of LSSPI, calculating the relative weights of LSSPI by pair-wise comparison, rating the LSSPI measures, calculating the performance scores, and ranking the companies based on their scores. Further to that, an Excel-based tool was developed for automating the calculation of LSSPI tool for automotive industry. In order to validate this tool, automotive experts were asked to confirm and comment in terms of their strengths, weaknesses and suggestions for improvement to enhance effectiveness in the implementation of LSSPI tool in Malaysian automotive industry.

Results:

This study has provided a comprehensive measurement instrument to implement the LSS practices, SCS and OP for Malaysian automotive industry. As a result, seven LSS constructs, four for SCS, and four measures for OP have been identified. They are as all fundamental resource for future researchers in developing and expanding this research. After a valid instrument is developed, this research prepared a structured relationship model among LSS, SCS, and OP. This research model is a mediator model in which it investigates whether the presence of SCS mediates the relationship between LSS and OP. The analysis result through the SEM method shown that SCS does not affect the relationship between LSS and OP. However, SCS improving OP when coupled with LSS.

Next, this study has developed the LSSPI tool based on the instrument of LSS, SCS, and OP which have been confirmed previously (refer appendix 1). In developing this tool, validation case studies have been carried out to one national car manufacturer and five automotive suppliers. Validation was carried out during the process of LSSPI system tool development it was conducted to one manager of Malaysian Automotive Manufacturer, and in five cases companies which are the suppliers to the local automobile manufacturers. In these case studies, a series of interviews involving LSSPI tool demonstration, explanation on the instructions in producing the relative weights by the automobile manufacturer and rating LSSPI scores of automotive suppliers were done. Furthermore, they provided comments and suggestions for enhancement of the LSSPI tool. This validation process also evaluated the capability and improved certain aspects of the system in terms of LSSPI tool specification, user friendliness and the effectiveness of this tool in the implementation of LSSPI in automotive companies.

The objective of the assessment is to validate the use and effectiveness of the LSSPI tool systems for Malaysian automotive industry. In order to achieve this goal, specific objectives in confirming the LSSPI are as follows:

- To evaluate the LSSPI guideline process in implementing a tool for the Malaysian automotive industry.
- To determine the effectiveness of the LSSPI tool system in measuring and determining assessment and selection process of suppliers.
- To determine the advantages, disadvantages and improvement suggestions of the LSSPI tool to be implemented in the Malaysian automotive industry

This section reports the feedback from the participants who responded to the questions and commented for further improvements. As described above, a total of six respondents from the automotive industry were involved in this assessment. Respondents were selected based on their expertise and experience in dealing with lean operation and performance measurement. The result shoes that majority of respondents from the automotive industry agreed on the assessment information and content of LSSPI interface in this tool. Based on these findings, it can be concluded that respondents were satisfied with the performance and effectiveness of the LSSPI tool based on excel system that is suitable in measuring and evaluating, and selecting suppliers in the automotive industry as a strategic tool, systematic, simple, user friendly, and save time for measuring and evaluating the performance of suppliers.

APPENDIX 1:

Lean Six Sigma Performance Improvement (LSSPI) Guideline

Fig. 1: Guideline LSS (main page).

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Fig. 2: Look Goal Setting.

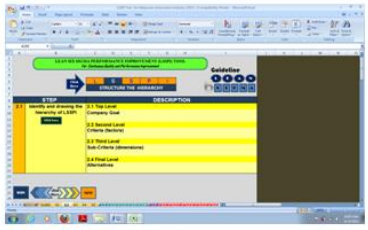

Fig. 3: Structure the Hierarchy **.**

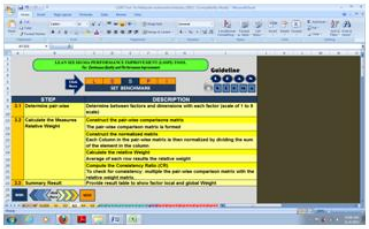

Fig. 4: Set the Benchmark.

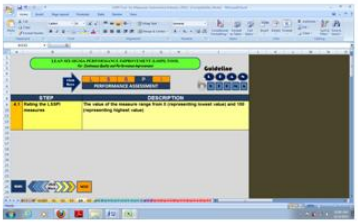

Fig. 5: Performance Assessment .

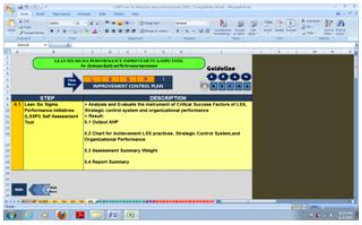

Fig. 6: Improvement Control Plan.

Discussion:

The results of the LSSPI evaluation tool are discussed under two main topics: the evaluation methodology of LSSPI guideline, and the LSSPI tool validation to identify the benefits, and its weaknesses. Finally, some suggestions for improving LSSPI tool will be presented.

The LSSPI guideline has been evaluated and confirmed by six automotive based companies. After the LSSPI tool demonstration, assessment and verification, all of the companies agreed that the LSSPI guideline is an appropriate methodology to determine and evaluate the vendors for automotive industry. LSSPI guideline

provides a step by step approach in determining the operational target as well as analyzing the techniques or process which can produce many improvement control activities towards achieving the targeted result. In addition, respondent believe that the LSSPI guideline is very clear for understanding and implementation of the LSSPI tool.

Furthermore, all the automotive experts also concluded that 5 steps of LSSPI guideline are technically adequate for assessing the lean operation, strategic control and OP in automotive industries. It also helps the company in determining the target that can be achieved which is considered as one of the benchmarking processes in encouraging companies to adopt a culture of continuous improvement.

From the evaluation given by the respondents, several benefits from LSSPI tool system can be identified. They are:

- LSSPI tool shows an effective and efficient way of managing supplier performance issues
- This tool can facilitate better implementation LSS, SCS, and OP in improving supplier performance
- The LSSPI tool process is user friendly, easy to use, systematic and practical thus can assist practitioners to understand the concept of LSSPI
- The tool is very structured, feasible and practical to be implemented in automotive industries to manage operational activities toward achieving better performance result
- The tool is comprehensive to manage overall performance of business operation and company systems
- LSSPI tool can still be applied although the manufacturers and assemblers are currently applying different manufacturing system
- Easy to assess and cost-effective in time for the documentation process.

Conclusion:

This study on the LSSPI tool development can help Malaysian automotive industry in enhancing the understanding and implementation of the LSS, SCS, and the OP so that the process and management of operations can become more effective and efficient. Based on the developed models and tools, the results of the study also provide guidance on implementation and recommendations to the Malaysian automotive industry. Consequently, it allows management to use strategic business system proposed by this study to develop and enhance the management of suppliers and increase OP. This is consistent with the government's intention to strengthen the management of world class quality operations and then return to lead the automotive industry in the ASEAN region.

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