

## Green Lean Six Sigma and Managerial Innovation in Malaysian Automotive Industry

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**ABSTRACT:** The purpose of this paper is to determine the relationship between the Green Lean Six Sigma (GLSS) and the Management Innovation (MI) to be implemented in the Malaysian Automotive Industry. This paper tries to examine how the GLSS can contribute and have a positive impact on the development of MI to achieve better performance in the automotive industry. In addition, by applying the advantages of innovation in an industry, they are able to ensure they have a competitive advantage factor. There are several elements that can be selected to support the GLSS and MI practices in the automotive industry. The relationship between structure MI and GLSS is proved by the use of Structural Equation Model (SEM) as recommended. Since this is a concept paper, most of the literature from the previous survey taken as a basic guide for this study as well as the construction of models of the relationship between the GLSS and MI is made. Next, the hypotheses can be generated based on the model of the proposed research and literature review. It has been shown that the MI which acts as an intermediary for the Malaysian automotive industry can continue to perform to make the transformation GLSS practice management system in the Malaysian automotive industry more efficiently and effectively in line with the industry to be the best among the competitors in other countries.

**KEYWORDS:** Green lean six sigma, managerial innovation, environmental, automotive industry, structural equation modeling.

### 1 INTRODUCTION

Malaysia is well known as the largest total passenger car market in ASEAN due to high purchasing power and the rapid growth of the economy. However, Malaysia has gone a step further in the automotive field to be car manufacturer after the establishment of Proton and Perodua instead of act as assemblers of motor cars only. Great opportunity can be achieved by the development of Small and Medium-Sized firms (SMEs) in the event of an increase in the ability to develop the industry. Malaysian automotive industry will face greater challenges from neighboring countries in Asia, especially Thailand when the implementation of AFTA in 2005. In this regard, Malaysia should take some steps to ensure there is a gap between the competitors.

Several research effort discussed in the literature indicate that companies who implemented the Lean Six Sigma (LSS) initiative show the significant environmental improvement by being extremely manage to improve efficiency, reducing costs, enhance customer response time, contribute to the quality, earn larger profits and upgraded public image [1]. In the proper way of implementation, among the advantages of the green system is able to build the company's image as a socially responsible organization and the environment as well as, the occurrence of a remarkable reduction of energy, generation of waste, and harmful materials. Production of green system are highly recommended by agencies such as the EPA, which strongly support of this research, especially if manufacturing LSS can act as a catalyst for the implementation the system so that this relationship can provide a lasting impression on the environment and performance organization.

Basically, the managerial innovation occurs when a goal is achieved through changes in how the organization of the work carried out, or significantly changes the shape of customs organization. According to previous studies, the purpose of innovation management is to enable the organization to use creative efforts to introduce new ideas in terms of production

and the efficient process [1]. This step is not only dependent on the research and development (R&D), but it deals all employees from each stage who can account for creative ideas for continuous development of the company.

Purpose of this paper is to determine and develop research model of the successful implementation of LSS has adopted the concept of 'green' to further enhance competition with other manufacturers and to evaluate its impact on the managerial innovation. At the same time, to identify measures that support improved management and things that hinder the process of improvement for Malaysian automotive industry using empirical study.

## 2 LITERATURE REVIEWS

### 2.1 GREEN LEAN SIX SIGMA IN MALAYSIAN AUTOMOTIVE INDUSTRY

Today, the automotive industry contributes significantly to the Malaysia's development in terms of creating skilled employment, deepening our Research and Development (R&D) capacity, and strengthening our component manufacturing and installation capabilities. However, the Malaysia's automotive manufacturer is in the spotlight as they have to compete with more experienced manufacturers in the automotive industry. A step should be taken to make their product is more competitive advantage and profitable. In a sense while history certainly informs the presents, ideas and perspective of the present may provide alternatively explanations and perspectives for understanding the past.

Many researchers have described the advantages of applying environmental strategies. For example, by implementing an environmental strategy, it can give different effects according to industries such as manufacturing or operation, energy consumption, raw material collection, marketing, disposal and waste management [2]. Traditionally, authorities and organizations have stepped up efforts to reduce polluting activities. However, referring to [3], the economic performance of an organization can be enhanced through innovation efficiency are responding by environmental regulations. In contrast to the small and medium manufacturers, their goal to use environmental strategy is not only supported by short term motivation, but also driven by strategic considerations. Consider on that situation, most small and medium sized manufacturers need to reload the cost of doing business to carry out an environmental strategy and rules ([4], [5]).

In ensuring that this can be done, lean not only act as exclusion errors initial but studies have been done to see how lean value system can be applied in the green strategy. Implementation of lean strategy in green into a unique blend can also be sure that it can help in the industrial sector [6]. Moreover, to attract customer, other approaches such as integrated quality tools that can be used as long as it is consistent with the actual objective lean. It means, whatever the concept of lean parallel to the goal of providing customer value and does not take much time, it is suitable for use with such as six sigma and green ([6], [7]).

As well as lean and six sigma since both have the same advantages. Both approaches can improve quality, shorten the processing and reduce the chance of defects. In addition, the function of lean is to eliminate waste, while six sigma was able to reduce variation and improve a number of elements that the products are at a satisfactory level. For the impact, both approaches may increase the company's performance. It was support by [8], six sigma is a concept which have the most precise linked with a defect in the quality and the elimination of change while, lean was associated with the scavenging efficiency and speed as in line with the goal of lean which is to reduce waste in all aspects of producing a product and accelerate the speed of a process.

Lean and six sigma approaches need each other due to lean applied in the organization, especially the lack of cutting edge manufacturing in services and technical compare six sigma is more focused on skilled workers in a quantitative approach. Thus, according to [9], the integration of lean and six sigma can help organizations build infrastructure improvements as a whole. This is indicates that both approaches give a positive impact on the performance of the organization as well as to create a combination of tools to analyze and find the best troubleshooting steps for organizations that implement them.

However, there is limited evidence of green, lean and six sigma consultancies have been combined into a working framework. Most of researches only focus on how to implement either combination of lean or green or six sigma with green, which are each of those approaches may affect the performance of the organization. Therefore, the integration approaches of Green Lean Six Sigma (GLSS) require the support by the number of elements with the various advantages could affect the performance of an organization who implements the approach. Those elements are leadership focus, training and education, structured improvement procedure and focus in metrics. A summary of those elements used in this research is given in Table 1.

Table 1. The advantages of elements on GLSS practice

Elements	Advantages of elements
Leadership Focus (LF)	On an ongoing basis improvement activities, cooperation and good communication and information operations spread quickly to achieve improvements in the quality of leadership if the concept is implemented effectively [10].
Training and Education (TE)	When the training and education has been implemented, it indirectly encourages employees always perform their duties with full dedication through enough skills. In addition, self-motivation can be developed through training and education where is in the end, result of their works are satisfactorily when all functions successfully applied effectively [11].
Structured Improvement Procedure (SIP)	To increase productivity, the organization proposed to adopt a structured improvement procedure. It is part of an organization that aims to provide knowledge and learning to the employees, to find a solution for a problem with quality and is a step in the strategy for the organization to carry out improvement projects ([10], [12], [13]-[14]).
Focus in Matrix (FM)	Quality management process can be enhanced when there is an understanding of an objective, efficient daily operation activities, intelligent manage tools and commitment among the employees of an organization to adopt the metric ([13]-[14])

## 2.2 MANAGERIAL INNOVATION IN MALAYSIAN AUTOMOTIVE INDUSTRY

In a recent year, the technology fast cycle, diversity and globalization move dramatically in the market of environment. In order to face these challenges, organization need to survive and grow for better management and gain a competitive edge going. This is also one step taken by an organization to create value for the competition toward pursue innovation [15]. Therefore, [16] suggest a method by stated that innovation is achieved by obtaining economic benefits from the creation and discovery. In other words, innovation is the renewal of a product, process, operation management and others to bring economic and convenience benefits to the organization and customers.

To increase productivity and performance at different stages of economic, organizations should consider implementing of innovation as a key factor for the development of a global organization. Innovation can be strengthened by empirical evidence as well as providing a positive impact on the organization ([17], [18], [19]). Therefore, comprehensive innovation model should be able to expect a difference and direction of innovation in the organization as a whole. Besides, organization also need to consider simultaneously all the factors explaining innovation in the organization of various different levels in order to build a comprehensive model of innovation ([19], [20], [21]). Therefore, organizations need to be more committed to adopt and carry out a lot of research to generate innovation as it is a huge shift in organizational management [22].

Referring to previous research, to ensure that this innovation practices can have a positive impact on the organization, there are several factors needs to be studies. According to [23], the implementation of practices innovation must know the roles undertaken as the transfer of coordination and integration implementation in order to make the innovation yielded effective and efficient. In addition, the successful of an organization can be seen when there are related idea norms of rational behavior [24]. This means, it can be said the successful implementation of managerial innovation is influenced by the actions of the organization.

However, the discussion of innovation is broad and large in scope. Therefore, organizations need to know what the ultimate goal of reform or change is to be made by them. This statement is supported by ([22], [25]), it is difficult to use the term organizational innovation as a broad scope to describe all kinds of innovation in an organization. Therefore, in order to create a sophisticated organizational structure and effective way to improve the complexity of the environment, practitioner of an organization must have an effective system and a good matrix ([19], [26], [27]). Thus, although innovation is a huge thing, but it still can be implement in accordance with the proper planning or in stages.

Various types of organizational innovation can be identified such as technology and administration or between product and process innovation ([22], [28]). This statement also supported by [16]. They highlight that, most studies of innovation performance is more focused on the company's internal innovation process, such as research and development in product innovation and improvement of production processes in terms of process innovation in a social system that disseminated and formed in the community.

In conjunction with that, an organization can determine the right choice either innovation of technical or prefer managerial through adequate level of technical skills or adequate capacity to establish effective interpersonal relationships [23]. Therefore, organizations need to make some research to identify problems that need to be improved, and then they

determine the category of innovation (technology or management) would apply where it can contribute to efficiency in the management and performance improvement.

However, as other practices, innovation will also deal with some problems or weaknesses. According to [29] and [30], the process of innovation implementation quite difficult to implement given the fluctuation customer's expectations and competitive pressures are broad and rapid technological change and radical innovation resulting in the change process becomes more complex, expensive and risky. Especially in the present situation where the market volatility and globalization require organizations to deal with the challenges of competition involving technology, management and organization [23]. Therefore, a structured planning and cooperation from various parties is needed. Many things need to be considered and emphasized as market conditions, the performance of competitors, technological advancements and customer requirements are taken into consideration so that the measures taken to innovation is appropriate to organizational goals.

Based on previous studies, it is believed that the problem of disadvantage of the use or development of the innovation can be overcome when there is a good management system. Coordination between technology production and methods of execution should exist, and that is the reason organization now needs to emphasize managerial innovation. This is because, according to [31], the division innovation of the organization into managerial and technology is very important for both sides where the type is and amount of organizations resources is different to ensure successful implementation.

For technological innovation, it is significant change and is very easy to spot in an organization. For example, it involves the use of new technology in the manufacturing procedure ([31], [32]). While technological innovations change the physical environmental, the implementation managerial innovation may covered the social system of organization ([31], [33]).

Managerial innovation can be identified by monitoring on a specific action related to the organization and it is as a measure to capture the potentially critical role of human agency in the process [34]. This reinforces the study by [22] that managerial innovation functions much focus on new ways to develop innovative manufacturing processes and advanced. In addition, the process of managerial innovation implementation requires understanding the role of self assessment and design better tools so as to avoid failure in implementation.

Study by [35] concludes that the process of change is divided into three phases; the first phase is making decisions and design, implementation phase and the phase of use. The three phases include the organization of action in deciding to adopt and implement management innovation designed hence it is used in the context of the organization and eventually when made practice of managerial innovation within an organization and planning. Therefore, organizational need to really understand the scope of what is required by the organization and use of the potential of an organization's progress in order to measure the application performance of managerial innovation.

Implementation of managerial innovation can be done effectively if supported and facilitated by a number of elements involving organizations especially among workers. Based on several previous studies, there are three elements that are identified may improves change in management. List of elements and their purpose contains of knowledge management, creativity skills and social culture is given in the Table 2.

**Table 2. The list of elements' purpose on managerial innovation constructs**

<b>Elements</b>	<b>Purpose of elements</b>
Knowledge Management (KM)	Excellent firms may support by the small groups but those structure of team-based able to contribute to the extent knowledge as a consequence of their mutual learning by enlarge or combination of their initial knowledge for achieve better management ([36]-[37]).
Creativity Skills (CS)	Creativity can be fully utilized when a person has a holistic knowledge of being able to think of something fresh and widely. As a result, employees may develop job satisfaction and improve their level of creativity [38].
Customer Perspective (CP)	When organization is committed to ensure the customer perspective, they automatically will strive to meet the demands and needs of customers. Thus, a variety of things that will try to improve by organizations such as producing affordable products, improve product and service quality for customer satisfaction and improve process management ([39]-[40])

### 2.3 THE RELATIONSHIP BETWEEN GREEN LEAN SIX SIGMA AND MANAGERIAL INNOVATION

Before to measure the relationship between green lean six sigma (GLSS) and the management of innovation (MI) is identify, the purpose and function of the green, lean, six sigma and managerial innovation needs to be understood for the first stage. This is to indicate the relationship of this approach can be pointed out and implemented by the organization's structures and processes accurately and efficiently. Definition of each of the practice that will be used in brief based on previous studies is given in Table 3.

*Table 3. The summary of definition on each practice implement in this research*

Elements	Advantages of elements
Green	The automotive industry should adopt environmental management practices in the design prior to production of a product, raw materials, recycling programs and to eliminate harmful substances that do not produce sewage wastes, toxic substances or air emissions, and accordingly, environmental performance can also be maintained ([41]-[42]).
Lean	The way of waste disposal, the use of continuous lean have an interest in developing velocity point creation procedure which is to increase its value and customer satisfaction. Separated from the target lean practices is to ensure smooth dumping design with restoration to the level of value, the use of processing, reduced transport time and viable production requires the upgrade process sustainable ([10]-[43]).
Six Sigma	Six sigma is a tool that can drive business to upgrade the purpose of obtaining and taking good explanation defects or lapse to go and arrange consistently upgrading and ready to focus attention on the yield variation in the production process ([44], [45]-[46])
Managerial Innovation	Managerial innovation as a change in management, work organization, working environment and expertise the workforce. Therefore, it can be concluded managerial innovation is a reform effort to create a more organized and perfect work environment [50].

Roughly, based on table 3, it shows each practice which are green, lean, six sigma and managerial innovation has similar goals. In short, GLSS integration can help organizations improve the quality of products or services. Despite the production is performed, it involves a variety of processes such as resource conservation and management of operational activities by applying environmental factors as a waste of resources-saving measures. Almost organization aims to make their product or service competitive advantage among its competitors and attract more customers directly. For the impact, the organization may earn higher profit. This is where the need for managerial innovation applied because it could change the working system normally undertaken by the management. With these changes, the organization is able to achieve the targets set parallel with the advantages offered by the GLSS. However, the integration between GLSS and MI practice must be proven by a number of previous studies that effective implementation can be done in an orderly manner to avoid errors or wastage in terms of cost and time.

Improve training development among employees is the importance role as growing rapid technological change. To ensure keep pace with industry advances in technology, employees should always be involved and maintain the process in acquisition of knowledge skills and acquired through formal education skills. However, the implementation of innovation will not only contribute to the understanding of the area's ability to process through the study of technology development, but also potentially beneficial innovations in the management process approach.

According to [36], action taken by management in any sectors of organization is different because it depends on the level of importance of environmental issues. But environmental pressure received by the organization to make them be far more proactive. In addition, he said that with the implementation of an environmental strategy, it assist bring the organization into a competitive advantage through cost savings and different products than those available in the market. This was shown by the attitude and technique in the application of environmental assist industries to achieve better performance. Consider all of this, organizations should implement environmental strategies as opportunities and be able to produce a competitive product or service.

Reference [38] stated that concept applied by the organization for the processing of products and implementation services usually fluctuates according to the rate of competition and technological shifts. Based on managerial innovation, it can shift from the normal activities of an innovation to the practice of effective new structure in short span of time. Learning techniques range from the lower level to upper management. In other words, the implementation of the overall innovation

occurs and its good approach for effective innovation management. Furthermore, with the support of innovation management, lean approach succeeded in changing markets and strategic development of the automotive industry. For example, in the product life cycle, lean undergoing the process of innovation has led to increase in product sales during the maturity phase.

While [48] had studied the implementation six sigma resulted organization which aims to dismantling process and eliminate waste from the appropriate organization and management when implementing six sigma in a structured manner. This strategy successful to achieve organizational goals by implemented with strategic tools and techniques in a strictly manner. Therefore, the management of an organization must have effective techniques for implementing six sigma with appropriate approaches. It is important to analyze a work process and practices improved design changes in management. Proper technique is also able to give an advantage to the organization to manage the allocation of resources when implementing six sigma [49].

### 3 RESEARCH HYPOTHESIS

The important of this paper are to explore the relationship between Green Lean Six Sigma (GLSS) and Managerial Innovation (MI) in Malaysian Automotive Industry. Therefore, the research hypotheses were developed. The hypotheses will be stated based on numbering system from H<sub>1</sub>. This style of hypotheses statement is chosen due to the nature of answering hypotheses using structural equation modeling methods. As a result of study in literature review, the following hypotheses of the study have been developed:

H<sub>1</sub>: There is a positive and direct significant relationship between GLSS practices and managerial innovation in Malaysian automotive industry.

### 4 RESEARCH METHODOLOGY

In achieving the objectives of the study, sampling method is used by using structured questionnaire. The population of this study comprised in Malaysian Automotive Industry and the data was obtained from Malaysian Automotive Components Parts Association (MACPMA), Proton Vendors Association (PVA) and Kelab Vendor Perodua (KVP).

SEM techniques was utilize to perform 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. 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. Structural Equation Modelling (SEM using AMOS 6.0) will use to test the measurement model.

### 5 A PROPOSED RESEARCH MODEL

Based on the literature review, it is hard to found empirical studies were investigating the relationship between GLSS and MI. Thus, this paper aims at analyzing of the relationship between GLSS and MI for Malaysian automotive industries. This model is called proposed research model as presented in Figure 1.

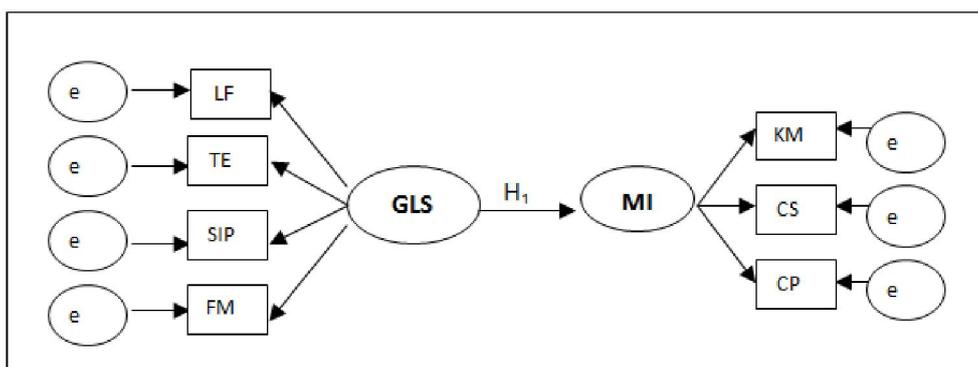


Fig. 1. Proposed Research Model for Green Lean Six Sigma and Managerial Innovation in Malaysian Automotive Industry

\*Note: GLSS=Green Lean Six Sigma, LF=Leadership Focus, TE=Training and Education, SIP=Structured Improvement Procedure, FM=Focus in Metrics, MI=Managerial Innovation, KM=Knowledge Management, CS=Creativity Skills, CP=Customer Perspective

## 6 CONCLUSION

This study aims to examine the relationship between Green Lean Six Sigma (GLSS) and Managerial Innovation (MI) to be implementing in the Malaysian automotive industry. Therefore, the hypothesis is created with strong evidence based on literature review. Various studies have shown that managerial innovation is one approach that can support of GLSS concept to be implementing by the Malaysian automotive industry. Based on previous research, organization should follow the process and procedures the application of managerial innovation, for achieve better organization performance. In addition, the efficiency and quality of the products also able to attract more customers in line with the advantages offered by the GLSS. In future agenda, the next step of this study is to design a questionnaire and investigate the relationship between GLSS practices and MI in Malaysian automotive industry.

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