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ISSN 2348-0416
USA CODEN: JASRHB

Journal of Applied Science And Research, 2013, 1 (1):17-27

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The Integrated Between Lean Manufacturing Practices and ISO 14001 Efforts in Malaysian Automotive Industry

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ABSTRACT

Lean manufacturing (LM) and ISO 14001 are business process strategies which are employed by the group of companies to enhance their production in manufacturing and business issues. LM focus on the systematic elimination of waste and non value added activity from the production process for improved environmental performance. ISO 14001 standard is an international standard that helps managers to reduce environmental impact and to expand business. This study is refer to analyze the drivers of LMP and ISO 14001 and how automotive industry can adapts LMP and ISO 14001 and which can effects on Environmental Performance (EP) for the innovation and competitive advantage of the automotive industry. Thus, the main purpose of this study is to develop structural analysis model of LMP and ISO 14001 in Malaysian automotive industry. The Structural Equation Modeling (SEM) has been proposed for conceptual model of this study. Base on the proposed conceptual model and reviewed, research hypotheses are being developed and the study culminates with opportunities for future research work.

Keywords: *lean manufacturing; ISO 14001; performance measurement; environmental management system; structural equation modeling; automotive industry.*

INTRODUCTION

The Malaysian automotive industry is one of the most important and strategic industries in the Manufacturing sector. Compared with other industries in the manufacturing sector, the Malaysia automotive industry has been identified to encourage the industrialization process for achieve nation vision by 2020. The announcement of the National Automotive Policy (NAP) in 2006 and its review in 2009, the Malaysian government further confirmed the previous policy of developing a national automotive industry of Original equipment manufacturer (Wad and Govindaraju, 2011). The NAP was introduced to facilitate the required transformation and optimal integration of the local automotive industry into regional and global industry networks within the increasingly

liberalised and competitive global environment. In addition, to help the NAP achieves one of their objectives which is to develop high value added manufacturing activities in niche areas.

In relation to that, by implementing LM practices, local automotive companies get benefit with eliminated waste in operation activities such as to reduce defect, reduce lead time, and decrease variation process, and also increase quality product and good service for customer responsiveness (Habidin et al., 2012).

In this era, LM widely accepted and grow development in manufacturing practice across countries and industries (Holweg, 2007). According to Taj (2008) LM started at Toyota with names such as Just in time (JIT) manufacturing or Toyota production system (TPS). Lean explains the significant revolution that was started by Toyota against a mass production system. In other word, lean means manufacturing without waste. Waste is anything other than the minimum amount of materials, equipment, parts, and working time that are essential to production. Waste has seven types: waste from overproduction, transportation waste, waste of waiting time, stock waste, waste of motion, processing waste, and waste from product defects. Besides that Sullivan et al., (2002) pointed out that the principles of the TPS has been widely adopted in recent years throughout the United States (US). In addition, application of TPS principles have led to LM for assist production and assembly cells consisting of product focused resources such as workers, machines, floor space, and other are closely linked in terms of their throughout times and inventory control.

Recently, LM and ISO 14001 have become a priority for most large business in Malaysia, and it related to their environmental performance has become increasingly common. According to Nee and Wahid (2010), ISO 14001 Environmental management System (EMS) refers to an organizations management system such as set of interrelated elements used to establish policy and objectives and to achieve those goals encompassed organizational structure, planning activities, responsibilities, practices, procedures, processes and resource used to develop and implement its environmental policy and handle its environmental aspects which follow to the ISO 14001 standards (ISO, 2004). However, Zutshi and Sohal (2004) presented that an EMS such as ISO 14001 is a voluntary system in organization and thus does not replace the existing regulations but provides guidance and flexibility in addressing both environmental and business strategic. In other words, the challenge of ISO 14001 standard to organizations utilizing lean manufacturing is to create a culture and sustain long term commitment from top management through the entire workforce (Prakash & Kumar, 2011). This support by Bamber et al., (2000) that implementing the internationally recognised EMS Standard ISO 14001, the business able to improve efficiency, enhance the competitiveness, and limit waste costs and other material, while at the same time meeting regulatory requirements and minimising business liability.

MATERIALS AND METHODS

Lean Manufacturing Practices

Companies in Malaysian increasingly focused on market demand and customers responsiveness. LM is known as a production practice that assumes the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a goal for elimination. Hence, this has led to the implementation and adoption of LM techniques in the automotive industry (Kumar and Abuthakeer, 2012). Besides that, Boyle et al., (2011) pointed out that lean has become accepted by academics and practitioners as the dominant approach in manufacturing management. This is because, LM is a manufacturing philosophy which focuses on delivering high quality products at the lowest price and at the right time. In addition, the focuses of LM is on eliminating waste or non value added activities. Besides that, according to Shah and Ward (2007), lean can considered from both a philosophical perspective that related to guiding principles

or the overall goal, and from a practical perspective, as a set of management practices, or techniques that benefit to observed directly. This is in consistent with the discussion of lean as a philosophy and a set of operational tools. According to these authors, the definition of lean as: an integrated socio-technical system whose main objective is to eliminate waste by simultaneously reducing or minimising supplier, customer, and internal variability. To generate a different constructs, an analysis of the proposed concepts was performed. Table 1 presents LMP practice constructs by different authors for each constructs.

Table 1. LMP constructs

Constructs	Related Constructs
Supplier Management	• Supplier relationship (Ogden and McCorriston, 2007; Shin et al., 2000; Kulmala, 2004), Supplier Quality Management (Yeung and Chin, 2004), Supplier Management (Foerstl et al., 2010), Supplier Involvement (Shin et al., 2000), Supplier Development (Shah and Ward, 2003)
Employee Involvement	• Employee involvement (Lin, 2006; Cottini et al., 2011; Maurer et al., 2008), Employee Morale (Maksoud et al., 2010), Employee Participation (Cabrera et al., 2003), Employee Satisfaction (Chen et al., 2012)
Just in time	• Just in time (Gyampah and Gargeya, 2001; Canel et al., 2000; Sakakibara et al., 1993) and time base manufacturing(Koufteros et al., 1998)
Customer Focus	• Customer Focus (Habidin and Yusof, 2012; On, 2006), Customer involvement (Shah and Ward, 2003), customer relationship (Li et al., 2005; David and Halligan, 2002)
Statistical Process Control to monitor quality	• Statistical process control (Rungtusanatham, 2001; Srikaeo et al., 2005), Quality information and analysis (Habidin et al.,2012)

Besides that, the theortical definition with a survey of lean practices applied in manufacturing automotive industry, and have identifying ten key practices: supplier feedback, JIT delivery, developing supliers, involved customers, pull, flow, setup time, controlled process, Total preventative maintenance (TPM), and involved employees. Such variables and techniques include, for example, setup time reduction, kaizen such as continuous improvement, multifunctional involvement in the process, 5S, kanban, JIT, and TPM (Shah and Ward, 2003: White and Prybutok, 2001). A summary of LM variables is given in Table 2. Besides that, the philosophy of lean considers the interrelationship of these practices in order to improve overall levels of quality, productivity, integration, and waste reduction with manufacturing, Research and development (R&D), accounting, and along the supply chain.

Table 2. Variables related to LM Practices

Lean manufacturing (LM) Variables	Measure	Source

Setup time reduction	• Formation of small production lots to reduce inventory in process and to increase variety.	Shah and Ward, 2003
Kaizen	• Kaizen has a strong appeal for many managers. • Promote systematic conclusion between operators and managers for better incremental continuous improvement.	Shah and Ward, 2003; Kilpatrick, 2003;
Continuous improvement	• Standardized throughout all areas within the firm. • The customer requirements are satisfied in terms of cost, quality and delivery times, and therefore, the competitiveness of the business increases.	Aguado et al., 2012
Multifunctional involvement in the process	• Development of top employee skills and incentive for autonomy to avoid failures throughout the process.	Shah and Ward, 2003
5S	• A form of visual management for reducing disorder and inefficiency in the productive and administrative environments. • Consists of the Japanese words 5s, Seiri (Sort), Seiton (Straighten), Seiso (Sweep & Clean), Seiketsu (Systemize) and Shitsuke (Standardize).	Abdullah, 2003; Shah and Ward, 2003
Kanban	• Used to manage these shipments process. • Kanban is an information system that is used to control the number of parts to be produced in every process.	Shah and ward, 2003; Abdullah, 2003
JIT	• As a tool for continuous production flow.	Jabbour et al, 2012; Shah and Ward, 2003
TPM	• TPM focuses on maximizing Overall Equipment Efficiency (OEE) with the all employee involvement in the organization. • Proactive and progressive maintenance methodologies and calls upon the knowledge and cooperation of operators, engineering, equipment suppliers, and support personnel to optimize machine performance.	Hashim et al., 2012; Shah and Ward, 2003; Kilpatrick, 2003

LM practice benefits is given in Table 3.

Table 3. Benefit of LM practices

Authors	Benefits

Sullivan et al., 2002	Reduced lead time; higher throughput; smaller floor space requirements; and lower Work in Process (WIP).
Tinoco, 2004	Lower costs; higher quality; and shorter lead times.
Aller and Garcia, 2010	Reduced cost; and improve relation with supplier.
Dudley, 2005	Ease of implementation; speed of implementation; reduction of inventory/cycle time; increase to customer satisfaction; increase to safety; and cost/benefit ratio.
Abdullah, 2003	Inventory reduction; reduced transport and material handling; better space utilization;lead time reduction; identification of causes of defects and machine problems; improve productivity; enhanced teamwork and communication; and enhanced flexibility and visibility.
Andersson, 2007	Reduced cycle times; increased floor space; improved working conditions; better work team performance; reduced lead times; improved inventory management; improved morale; reduced search time; improved delivery time; improved access to information; and increased levels of commitment.
Rashid et al, 2010	Reduced the lead time; reduced manpower usage; and balanced the workload.
Kilpatrick, 2003	Reduced lead time; increased productivity; reduced WIP inventory; improved quality; and reduced space utilization.

Lean practices encourages the consideration of the value stream of products the flow of processes from extraction of materials, right through to end products. This is because Value Stream Mapping (VSM) practices that being implemented in lean production system to make the improvement in the production (Bigg, 2009). Besides that, it used to analyze the flow of materials and information currently required to bring the product to the consumer. VSM maps all the steps in this value stream such as extraction of raw materials, processing, transporting, forming, assembling, waiting, and storage against time, assist companies to understand the value stream, estimate the percentage of the time that is adding value to the customer and work out where wastes are occurring. In addition, VSM is used to first map the current state and then used to identify and eliminate waste (Abdullah, 2003). Besides that, Dudley 2005 pointed out that VSM and associated analytical tools are used to see the opportunities to coordinate the flow of products on the floor with a focus on reducing inventory and improving quality.

Normally, large machines characteristic of automatic processes referred to as monuments are often no longer aligned with lean working methods and are not needed or desired. However, smaller more flexible machines are typically organized into working methods focus to the production of a family of products (Sullivan et al., 2012). For example, workers operate the machines in the system to minimize the cycle time for a family of products, minimize inventory, and maximize quality. However, to stay competitive, business should try to make their manufacturing facilities more efficient and effective. Traditionally, managers have depend entirely on financial performance to determine efficiency. This is because, financial alone are not enough for managing a lean manufacturing operation. It mean that managing a lean factory requires important information that reflects what is happening in the company (Taj, 2008).

ISO 14001 Standards

Many environmental experts have seen the improvement expansion of LM activities sweeping across diverse commercial and manufacturing sectors. This growing number of environmental professionals see an exciting opportunity to leverage this trend for better environmental results more effectively. Following both the Rio Conference in 1992 and GATT (General Agreement on Tariffs and Trade) negotiations, international standards have become important for succeeding and for getting access to the markets; at the same time, there has been an increase in the interest of environmental management. This is because such regulatory and competitive pressures have caused firms to take into consideration the environmental issues within their own production and market plans. Many firms have attempted to seek an effective EMS. These also have led to implementation and development of the ISO 14001 standard for assessing environmental management processes (Turk, 2009).

EMS is currently defined as a set of documented policies, processes and procedures, with the goal of ensuring the effective implementation of an environmental management plan, and compliance with environmental policy, objectives and targets (Horokou, 2004; Chavan and Naik, 2005; Russo, 2007; Homes, 2011; Cassells et al., 2012). Usually, these management systems take the form of an environmental version of quality methodology (Plan, Do, Check, and Act) management process, that includes: a statement of the organizations environmental policy and goals, a planning process comprising the identification of environmental aspects and the definition of measurable environmental objectives, implementation procedures such as responsibilities, training, and reporting requirements, procedures for monitoring and for dealing with preventive and corrective action; and a review process to improve both the goals and elements of the EMS itself. Other than that, ISO 14001 standard specifies a series of requirements that must certified for assist company to organize and coordinate all the environmental activities and initiatives that the company develops. This standard is intended to be useful to those companies that wish to become involved with a more proactive environmental management, and its implementation allows the company to obtain a certificate of compliance that recognizes that the EMS meets the established requirements (Gonzalez-Benito and Gonzalez-Benito, 2008).

ISO 14001 is considered the only standard designed for the purpose of audit and certification in the ISO 14001 series (Franchetti, 2011). The key elements of ISO 14001 include environmental policy, planning, implementation and operation, checking and corrective action, and management review (Cassells et al., 2012; Rodriguez et al., 2011; Liyin et al., 2006). Table 4 shows the summary of ISO 14001 measurement. According to Gbedemah (2004) environmental policy and planning starts with the assessment of the environmental aspects and impacts of the organizations activities, products and services. In addition, documentation also important in any EMS because to assist company in term of implementation the operation process. For example, document control involves designation of someone to be responsible for update and change. Then, operations and activities must be controlled to ensure that policy addressing the most significant environmental aspects is carried out. All of this stage aims to examine how the firm performs in terms of environmental management and to investigate the causes of problems, identify possibilities for improvement and take subsequent action to realize these changes. Operations and activities of environmental practices able to monitored, their performance measured and compared with the goals and targets, and compliance with regulations assessed. Finally, management review also contribute for continues produce the desired effects as outlined in the policy. Other than the important data obtained from audits, other internal reports on performance and occurrences, external reports on regulatory and environmental changes, and suggestions for improvement received from internal and external sources involve as a role for the organization to act upon

Table 4. ISO 14001 measurement

Factors	Measurement	Reference/ Authors
Management approach (MA)	Environmental policy; planning; and management review	Pun et al., 1998; Sambasivan & Fei, 2008
Organizational change (OC)	Implementation and operation	
External and social aspects (ESA)	Government regulation; market pressure; and customer requirement	
Technical aspects (TA)	Checking; and corrective action	

Previous study showed the different benefit or advantages for implementation of ISO 14001. For example, Chavan (2005) pointed out that an EMS can be a powerful tool for organizations to both enhance their environmental performance and improve their business efficiency. It can assist the top manager in term of minimizing environmental liabilities, maximizing the efficient use of resources, reducing waste, building awareness of environmental concern among employees, enhance the image of an organization, gaining better understanding of the environmental impacts of business activities and increasing profit through more efficient operations. Zutshi and Sohal (2004b) asserting that wide involvement of employees should be encouraged at a very early stage of the EMS implementation in order for effective change management, and reduction of employee protest toward the EMS. In addition, employee participation is needed by ISO 14001, to the extent that communication and training is mandated (ISO, 2004), there is evidence to suggest that its importance is not fully understood by organisations.

The study by Homens (2011) showed that an EMS provides is the combination, at all levels of an organization, of a structured and systematic approach to manage environmental aspects, setting a clear definition of the organizations environmental values and the commitment toward regulatory compliance. In view of that, a range of different benefits may result from the implementation of an EMS such as risk reduction costs, identification of improvement opportunities, adoption of innovative practices, enhanced operational efficiency, internal cost savings, compliance assurance, improved relationship with regulators, improved documentation and information management, and increased environmental awareness. Thus, ISO 14001 brings about the achievement of environmental objectives and cost reductions, as its adoption reduces the firms environmental impact and improves aspects of operational efficiency and effectiveness (Nishitani, 2010). Next, Chavan and Naik (2005) stated that ISO 14001 provides an external benefit such as enhance compliance, prevent pollution and conserve resources, reduce risks, attract new customers and demands, increase efficiency, enhance employee morale, enhance recruitment of new employees, enhance image with public, regulators, lenders, investors, improve employee awareness of environmental issues and responsibilities and qualify for recognition.

The Relationship between Lean manufacturing Practices and ISO 14001

World class manufacturing (WCM) can only be attained through an organization adopting a system of continuous improvement and focus is on the elimination of wastes. According to Bamber et al., (2000) the factories of WCM must be lean producers, characterised by team working, commitment to quality, highly responsive processes and flexible machinery which can all be conveyed by the implementing TPM. As such, the certification of the EMS to the requirements of ISO 14001 was achieved in short processing time, through the use of a goal oriented program aimed at integration of manufacturing systems, utilising the commitment of management to continually focus on TPM improvement.

To ensure the relationship between LM practices and ISO 14001, research by Puvanasvaran et al., (2012) stated that lean and ISO 14001 are the most important business process strategies which are employed by companies to improve their manufacturing performance and business efficiencies. They also mentioned that lean and ISO 14001 assist company in order to focus on manufacturing proactivity or the tendency of a firm to implement advanced technologies in order to increase the production and operations capacities.

Ho (2012) presented that develop a working model integrating ISO 14001 and 5S. Integrated this model showed the benefit such as assist companies to effectively achieve safety, hygiene, quality productivity, image, cost reduction, environmental protection and timely delivery. Besides that, Aguado et al., (2012) explained that the model of efficient and sustainable improvements in a lean production system through processes of environmental innovation allows a business to identify and quantify the improvements made. In relation to these economic and social criteria, businesses must identify the environmental aspects, which are understood as the elements of the activities, products or services in an organization capable of interacting with the environment.

A Proposed Research Model

Based on comprehensive review of previous study, a conceptual model has been proposed to relationship between LM practices and ISO 14001 as presented in Figure 1. To more understand the relationship between LM practices and ISO 14001 performance efforts in Malaysia automotive industry, the following hypotheses will be used and tested. LM practices give many affect on an organizations management as increase production, management efficiency, eliminate waste and others. Thus, these hypotheses have been developed based on the proposed conceptual model and previous studies.

There is a positive and direct significant relationship between lean manufacturing practices and ISO 14001 performance efforts in Malaysian automotive Industry; H1:

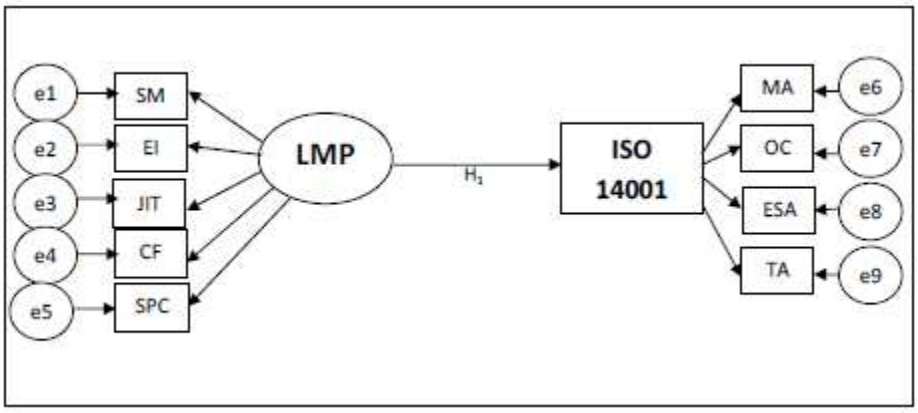

Figure 1 Proposed Model of the Study

*Note: SM= Supplier Management, EI= Employee Involvement, JIT= Just in time, CF= Customer Focus, SPC= Statistical Process Control, MA= Management Approach, OC= Organizational Change, ESA= External and Social Aspect, TA= Technical Aspect,

Methodology

The Malaysian automotive industry is characterized by the structure of the domestic manufacturing to develop the production of passenger vehicles (Henriksson, 2012). In this study, sampling method by using structured questionnaire. In achieving the objectives of the study, the Malaysian automotive suppliers firms were selected as the population. The data was obtained from PROTON Vendor Association (PVA) and Kelab Vendor PERODUA (KVP). These lists of automotive suppliers consist of electrical, electronic, metal, plastic, rubber, and other automotive part.
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

RESULT AND CONCLUSION

In the conclusions, LM practices and ISO 14001 has become most important in Malaysia automotive industry. It aims to identify the relationship between LM practices and ISO 14001, especially LM practices are an important business strategy that can be focus on improvement of the quality and to eliminate waste in the Malaysian automotive industries. In addition, each of the LM practices will enable an organization to identify the main environmental impacts on organization. Besides that, the company needs to use LM practices to be the most significant to implementing ISO 14001 performance efforts. Based on the conceptual model and previous studies also, the hypothesis has been constructed. The next step is to design a quality questionnaire to ensure that research objectives are achieved. This questionnaire will be used on the future for pilot study data collection in the Malaysian automotive industry.

ACKNWLEDGEMENTS.

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).

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