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The Development of Sustainable Manufacturing Practices and Sustainable Performance in Malaysian Automotive Industry

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Abstract
This paper shows a model to conduct an empirical study in Malaysian automotive industry in order to improve their sustainable performance. The problems of sustainability are becoming a global concern by many manufacturing companies especially in automotive industry. The sustainability research in this study targets the measures and studies at the three basic elemental levels involved; environmental, economic and social. The presented review categorizes the literature into three main research areas; sustainable manufacturing practices, sustaining lean improvements, and sustainable performance. Also, the text attempts to draw the link between these research themes, expose any relationship and inter-relationships, and discuss the physics behind some of the sustainability models presented to analyze the automotive sustainability.
Keywords: Sustainable Manufacturing Practices; Sustaining Lean Improvements; Sustainable Performance; Automotive Industry

Introduction

The automotive industry, including the motor vehicle parts industry, is highly desired by many countries as a driver of economic growth, job creation, and technology development. The countries of the ASEAN region are no exception. They have succeeded at developing individual automotive industries over the past decades in part through the use of local-content requirements, high tariffs, investment incentives, and tax policies designed to promote and protect their respective industries (ASEAN: Regional Trends in Economic Integration, Export Competitiveness, and Inbound Investment for Selected Industries, 2010). Moving forward into 2011, the industry is set to strengthen gradually but at a modest pace, in line with regional and global auto demand recovery, in view of several rounds of interest rate hike and higher petrol prices (Malaysia Automotive Economy Trend and Outlook, 2011). In fact, according to the Malaysian Automotive Association (MAA), production of motor vehicles for 2011 totaled 533,515 units comprising 488,261 units of passenger vehicles and 45,254 units of commercial vehicles. Sales of motor vehicles amounted to 600,123 units in 2011 consisting of 535,113 units of passenger vehicles and 65,010 units of commercial vehicles (Malaysia Investment Performance, 2011).

In this era, the role of sustainable within the manufacturing automotive industry has change and matured in the dynamic business environment. In generally, the issue of sustainability has become a critical issue for the business world (Prahalad and Hammond, 2002; The UN Global Compact, 2004; Hawken, 2007) although sustainability is still a vague concept, there is growing consensus that it is necessary to move from trying to define it toward developing concrete tools for promoting and measuring achievement (Veleva and Ellenbecker, 2000). In addition, sustainability in manufacturing area has received enormous attention in recent years an effective solution to support the continuous growth and expansion of manufacturing industry (Yuan et al., 2012). According to Jayal et al. (2010), to achieve the sustainable manufacturing requires a holistic view spanning in product, manufacturing processes and supply chain including the manufacturing systems across multiple product life-cycles. In particular, recent trends in developing improved sustainability scoring methods for products and processes, and predictive models and optimization techniques for sustainable manufacturing processes.

Therefore, it can analyze the importance of these issues through the lenses of several well established theoretical perspectives. From a resource-based view of the firm, sustainability may constitute a valuable, innovation, and hard to imitate resource or capability that leads to competitive advantage (McWilliams and Siegel, 2001). In term of competitive advantage, a good sustainability strategy must first be a good business strategy that first an

organization's unique value-chain opportunities and threats (Porter and Kramer, 2006; Siegel, 2009).

Considering the complexities involved in the above-mentioned focus areas for sustainable manufacturing, optimized solution, and corresponding underlying models, are necessary. Therefore, this paper presents an overview of recent trends, and new challenges, for achieving sustainability at the manufacturing practices, lean improvement, and performance, with a focus on modeling and optimization aspect.

1.1 Sustainable Manufacturing Practices (SMP)

Since the turn of the new millennium, drives towards SMP have been getting stronger and stronger in most part of business and society (Seidel et al., 2007; Jafartayari, 2010; Millar and Russell, 2011; Vinodh and Joy, 2012; Rosen and Kishawy, 2012). The efforts of manufacturing industries to achieve sustainable manufacturing have shifted from end-of-pipe solutions to a focus on product lifecycles, and integrated environmental strategies, and management systems. Furthermore, efforts are increasingly made to create closed-loop, circular production systems and adopt new business models (OECD, 2009).

In many other countries in the Asia-Pacific region and the USA expect economic, social, and environmental factors have also started to make manufacturing companies consider sustainability more seriously (Seidel et al., 2007; Jayal et al., 2010; Gunasekaran and Spalanzani, 2011). Following Flanagan et al., (2003), European citizens' support the government's coordinating, and regulating role to reconcile the economic, environmental, and social dimensions of sustainability. Therefore, sustainability has become a primary competitive factor for many manufacturing companies in Europe (Flanagan et al., 2003; Seidel et al., 2007).

Other previous studies also concur on the need of Malaysian manufacturing industry. Sustainable Development Initiatives in Malaysia (2010) has had the privilege to talk with three multinationals that are based in Malaysia; namely, Panasonic, General Electric (GE), and TOYOTA. These companies shared their practices in different ways, and thinking of achieving sustainable development. As a manufacturer of electronic products, Panasonic takes responsibility to preserve the natural environment that sustains life on earth for future generations. As a consumer, industrial products, and services, GE looks seriously on green environment in the areas of aviation, commercial aviation services, traditional, and renewable energy systems, oil and gas, transportation, as well as water, and process technologies. Due to environmental issues, Toyota as a vehicle manufacturer has taken many green initiatives to ensure that their products and services are environmental friendly. More information about the Malaysian manufacturing industry need is given in Table 1.0.

Based on the current needs, SMP implementation gives many benefits to our country from social, economic, and environmental aspect. Some of the strongest sustainability decision drivers reported in Fairfield et al. (2011) study such as spurring innovation and growth, enhancing reputation and image, avoiding regulatory entanglements, and attracting and retaining top talent - are those often identified as among the strongest corporate benefits of sustainability strategies (Savitz and Weber, 2006). The specific decision drivers and practices reported by this much larger sample are congruent with Bansal and Roth's (2000) drivers of competitive advantage and legitimating, with less impact form social responsibility. Further, these results are consistent with Basu and Palazzo's (2008) such as stakeholder-driven, performance-driven, and motivation-driven rationales for corporate social responsibility. The anticipated approaches in Table 2.0 can help meet the benefit of SMP Implementation.

After having a thorough literature review, this paper has identified these four critical factors, namely: (1) manufacturing processes; (2) supply chain management; (3) social responsibility; and (4) environment management (Refer Table 3.0).

1.2 Sustaining Lean Improvements (SLI)

This paper focused on three aspects during a lean implementation which, due to a lack of literature on these topics, are often disregarded, leading to short term improvements that cannot be sustained over a longer period of time (Schlichting, 2009).

For this paper's proposed that sustaining lean improvements depends on three aspects. Firstly, standards work (Murphy, 2001; Foschi, 2009). A study by Foschi (2009) states that the role of three factors in task group: level performance, performers' status, and standards used to judge ability. On the other hand, the focus is on the use of different standards for competence for members of various status categories. Nevertheless, Murphy (2001) has largely ignored the performance standard, which generates important incentives whenever plan participants can

influence the standard-setting process. Internally determine standards are directly affected by management actions in the current or prior year, while externally determine standards are less easily affected.

Secondly, employee involvement (Cabrera et al., 2003; Jones and Kato, 2005). Currently most researchers agree that competitive environment is one of the major causes of the increase in the use of participative management practices. This is clearly supported by Cabrera et al. (2003) results, which showed a highly significant positive relationship between competition and employee involvements. Jones and Kato (2005) presented an econometric case study for employee involvement on firm performance. One of the findings showed that employee involvement will produce improved enterprise performance through diverse channels including enhanced discretionary effort by employees.

Last but not least is continuous improvement. Caused by an increasing rate and complexity of business environments, organizations no longer compete on processes but the ability to continually improve processes (Teece, 2007). At the same time numerous organizations that have deployed continuous improvement initiatives have not been successful in getting what they set out to achieve. Results of a 2007 survey of US manufacturers showed that while 70% of plants had deployed lean manufacturing techniques, 74% of these were disappointed with the progress they were making with lean (Pay, 2008).

1.3 Sustainable Performance (SP)

The successful implementation of sustainable development could improve more than one dimension of sustainable performance such as environmental sustainability, economic sustainability, and corporate social responsibility sustainability (Moldan et al., 2012; Schoenherr, 2011; Bartelmus, 2010; Singh et al., 2009; Labuschagne et al. 2005; Veleva and Ellenbecker, 2001). According to the sustainability literature, there have been various dimensions of the sustainable performance that were used by previous studies. Table 4.0 summarizes the sustainable performance literature.

1. A Proposed Conceptual Model

Based on comprehensive review of previous study, a conceptual model has been proposed to model the relationship between SMP and SP as presented in Figure 1. This proposed model has adopted the conceptual proposed by Millar and Russell (2011) and Fairfield et al. (2011). However, some amendments especially on SMP implementation and SP constructs have been made.

2.1 The relationship between SMP and SP

In sum, every critical factors of SMP can lead to excellent SP. In addition, numerous researchers have indicated a positive impact between SMP and three dimension of the triple bottom line such as environmental sustainability, economic sustainability, and social corporate responsibility sustainability (Jayal et al., 2010; Gimenez et al., 2012; Vinodh and Joy, 2012; Rosen and Kishawy, 2012).

To ensure the relationship between SMP implementation and SP, research by Kaebernick et al. (2003) have presented the integration of environmental requirements throughout the entire lifetime of a product. They presented the concept of an approach to product development, based on a paradigm for sustainable manufacturing which is reflected in a new way of thinking, new application tools and methodologies in every single step of product development. In fact, an industry case study shows that the implementation of the new paradigm can lead to new market opportunities for a company.

The results are consistent with findings in Rusinko (2007) has presented an evaluation of environmentally sustainable manufacturing practice and their impact on competitive outcomes. The author presented an exploratory study of the relationship between specific environmentally sustainable manufacturing practices and specific competitive outcomes in a US-based commercial carpet industry. Findings suggest that environmentally sustainable manufacturing practices may be positively associated with competitive outcomes. In particular, different types of environmentally sustainable manufacturing practices are associated with different competitive outcomes. These specific findings can be helpful to engineering and operations managers as they respond to environmental and competitive demands.

2. Methodology

In this study, sampling method by using structured questionnaire. 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, one statistical technique was adopted.

Structural Equation Modeling Techniques (SEM) 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. 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 Modeling (SEM using AMOS 6.0) will use to test the measurement model.

This study is expected to arrive at the following conclusion: This study has important implication for SMP and SP in Malaysia automotive industry. As such, it is expected to benefit both researchers and practitioners.

3. Discussion

Many studies have been performed to identify critical success factors for successful SMP implementation. However, no previous study had tried to investigate the relationship between SMP implementation and SP, especially amongst automotive industry in Malaysia. A conceptual model has been proposed to examine the relationship between SMP implementation and SP measures relationship for Malaysian automotive industry. To understand the relationship of SMP implementation and SP in Malaysian automotive industry, the following hypothesis will be used and test.

H_1: There is a positive and direct significant relationship between SMP implementation and SP in Malaysian automotive industry

4. Conclusion

In brief, the findings of this research can be benefited, used and contribute not only to academic but also to the industry, especially to the suppliers development, and improvement division and to the Malaysian automotive practitioners as a whole in making the model, and the tool of this study as a benchmark to serve as a guide and reference resources to implement SMP initiatives, SLI, and SP.

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Table 1.0: Malaysian Manufacturing Industry Need

Company	Malaysian Manufacturing Industry Need
Panasonic	1. To engage society to carry out the green environment; 2. To produce environmental friendly products; and 3. To educate and train employees to ensure that the Panasonic plant is environmental friendly.
General Electric	1. Increase revenues from ecomagination products; 2. Double investment in R&D; 3. Reduce Greenhouse Gas (GHG) emissions; 4. Improve the energy efficiency of GE's operations; 5. Reduce water use and improve water reuse; and 6. Keep the public informed.
Malaysia Green Technology Corporation	1. Green technology; 2. To minimizes growth of resources consumption; 3. To minimizes degradation to the environment; 4. Promotes healthy; and 5. Improved environment.
Toyota	1. Increased environmental awareness; 2. Better systems of work; 3. Better environmental performance; 4. Requires foundation of enforceable standards; 5. Substantial cost savings; and 6. Better public information and transparency.

Source: Sustainable Development Initiatives in Malaysia (2010)

Table 2.0: Benefit of SMP Implementation

Category	Benefit of SMP implementation	Authors
Social	- Improves personal health - Enhance operational safety	Jayal et al., 2010; Sustainable Development Initiatives in Malaysia, 2010.
	- International standards and protocols - Increased compliance requirements	Sustainable Manufacturing: Manufacturing for Sustainability, 2008.
	- Community expectations will drive consumer choices to more sustainable products and services	Sustainable Manufacturing: Manufacturing for Sustainability, 2008.
	- Competitive advantage and legitimating with less impact from social responsibility motivation	Basu and Palazzo's, 2008; Fairfield et al., 2011; Sustainable Manufacturing: Manufacturing for Sustainability, 2008.
	- Gain the company image	Savitz and Weber, 2006; Seidel et al., 2007; Fairfield et al., 2011.
Economic	- Spurring innovation and growth	Savitz and Weber, 2006; Blackburn, 2007; Fairfield et al., 2011; Sustainable Development Initiatives in Malaysia, 2010.
	- Cost associated with compliance will increase while companies will come under greater scrutiny form financial analysts	Sustainable Manufacturing: Manufacturing for Sustainability, 2008.

	- Increase number of sales	Seidel et al., 2007.
	- Reduce cost	Jayal et al., 2010; Sustainable Manufacturing: Manufacturing for Sustainability, 2008.
	- Competition in the market-place will drive new inventions, innovation and technologies	Sustainable Manufacturing: Manufacturing for Sustainability, 2008.
	- Increase product desirability	Seidel et al., 2007.
	- Employee to more responsible and respected employers	Sustainable Manufacturing: Manufacturing for Sustainability, 2008.
	- Maintaining/increased profitability and productivity	Rosen and Kishawy, 2012; Sustainable Manufacturing: Manufacturing for Sustainability, 2008.
Environmental	- Significant reductions in energy usage - Savings in waste disposal are achievable	Seidel et al. 2007; Nagel and Tomiyama, 2004; Jayal et al., 2010; Sustainable Development Initiatives in Malaysia, 2010.
	- Improving energy efficiency - Sustainable plants	Bovea and Wang, 2007; OECD, 2009.
	- Improve their environmental performance	Nagel and Tomiyama, 2004; Sustainable Manufacturing: Manufacturing for Sustainability, 2008; Jayal et al., 2010; Rosen and Kishawy, 2012; Sustainable Development Initiatives in Malaysia, 2010.
	- Avoiding regulatory entanglements	Savitz and Weber, 2006; Blackburn, 2007; Fairfield et al., 2011.
	- Ensuring clean and green atmosphere	Sadiq and Khan, 2006.

Table 3.0: SMP Constructs and Their Measurement Items

SMP Constructs	Literature/Authors	Review of The Authors
Manufacturing Processes	Millar and Russell (2011)	More than half of the firm surveyed (55%) are using water-based paint and 50% are using biodegradable materials. The results shown seem to indicate that Caribbean manufacturers have adopted a number of practices related to their input materials that promote sustainable manufacturing. 83% of the firms have implemented processes to minimize waste and 78% have sought to minimize the negative impact of their production processes on the work environment. It is interesting to note that energy efficiency was not a top priority for Caribbean manufacturers in the design and operation of their manufacturing processes.
	Fairfield et al. (2011)	Respondents perceived competitive disadvantage as a deterrent to sustainability management or that their company's inclination to move toward sustainability was muted by a lack of pressure from stakeholders. Average items are under each factor to produce three five-point scale scores: Practices 1 – Integration/Alignment (α=0.94), Practices 2 – Eco-efficiency (α=0.88), and Practices 3 – Employee-centered/Ethics (α =0.79).
Supply Chain Management	Millar and Russell (2011)	32% of the respondents claim to source materials/products from environmentally friendly suppliers, while only 22%

		encourage suppliers to use recycled materials. 18% of the respondents have forged partnerships with suppliers to promote sustainable manufacturing.
Social Responsibility	Millar and Russell (2011)	97% claim to promote the health, wellbeing and safety of workers. 84% are committed to diversity in hiring and promoting employees and 80% donate to community programmers. Less than half of the firms (32%) give to international disaster relief efforts, while more than half (60%) use social responsibility as a strategy for creating brand loyalty.
Environment Management	Fairfield et al. (2011)	Average items are under each factor to produce four five point scales scores: Drivers 1 – Environmental/Operational Issues (α=0.93), Drivers 2 – External stakeholder/Marketplace issues (α=0.90), Drivers 3 – Workplace issues (α=0.75), and Drivers 4 – Reputation/ Innovation/Compliance issues (α =0.68)

Table 4.0. Dimensions of Sustainable Performance Variable

Dimension	Literature/Authors	Lean/Quality Initiatives
Environmental Sustainability	Schoenherr (2011)	1. Provide further motivation for firms to implement environmental initiatives; 2. Increase the customers' perception of the plant's product in the marketplace; 3. Increasing the implied or perceived quality performance; and 4. Increase a plant's competitive advantage.
	Hermann et al. (2007)	1. Complete in that it includes parts of the production chain that are outside the boundaries of the industrial system itself; 2. Making the results easy to interpret for policy purposes; and 3. Uses readily available information.
Economic Sustainability	Kumar and Sutherland (2009)	1. Decrease the price paid to the last user when purchasing an EOUP; 2. Increase the selling price of the hulk; and 3. The overhead cost will be greatly increased because of increased levels of dismantling.
CSR Sustainability	Hutchins and Sutherland (2008)	1. Corporate actions can be used to effect positive social change; 2. Establish a comprehensive social footprint for a company; 3. Form a single social sustainability metric for a company; and 4. Form a single measure of performance for a supply chain.
	Flack and Heblich (2007)	1. Involve a long-term shareholder value approach; 2. A long-term view of profit maximization; 3. In the case of manager-led companies, this will make necessary a change in incentive structure; and 4. A company's goal to survive and prosper, it can do nothing better than to take a long term view and understand that if it treats society well, society will return the favor.

*Note: SMP = Sustainable Manufacturing Practices, SP = Sustainable Performance, MP = Manufacturing Processes, SCM = Supply Chain Management, SR = Social Responsibility, EM = Environment Management.

Figure 1. Model for SME Framework