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Sustainable manufacturing practices in Malaysian automotive industry: confirmatory factor analysis

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Abstract

Sustainable manufacturing practices (SMPs) have received enormous attention in current years as an effective solution to support the continuous growth and expansion of the automotive manufacturing industry. This reported study was conducted to examine confirmatory factor analysis for SMP such as manufacturing process, supply chain management, social responsibility, and environmental management based on automotive manufacturing industry. The results of confirmatory factor analysis show that four factors for SMP implementation in Malaysian automotive industry were developed and verified. For the next agenda, the authors are looking at the confirmatory factor analysis of sustaining lean improvement in Malaysian automotive industry. The paper proposed with a future direction end of this research.

Keywords: Sustainable manufacturing practices; Confirmatory factor analysis; Manufacturing process; Supply chain management; Social responsibility; Environmental management; Automotive industry

Background

Strategically located in the centre of Association of Southeast Asian Nations (ASEAN), Malaysia offers vast opportunities for global automotive and component manufacturers in order to set up manufacturing and distribution operations. Evidence show that Malaysia has been attracted global automotive companies (e.g. Toyota, Honda, Nissan, BMW, and Peugeot) and international component manufacturers (e.g. Delphi, Continental, Denso, and Bosch) in order to launch their product in this country and meet the highest consumer demands (Malaysian-German Chamber of Commerce and Industry 2012). However, Malaysian government should also regulate the entry of foreign products in order to ensure the local automotive performance can survive in the local and global market. Thus, a regulatory structure practice was gazette to protect and control the automotive manufacturing activity. South Africa, for example, could sustain their economic performance by adopting an import substituting policies (Barnes et al. 2004).

Due to the rise in these issues, the awareness of Sustainable Manufacturing Practices (SMPs) has become an important element in manufacturing industry. A number of researchers have attempted to refine this broad array of SMPs into the framework.

Similarly, to support the continued growth and expansion of the manufacturing industry, SMPs are the best approach (Laosirihongthong and Dangayach 2005; Yuan et al. 2012). In Malaysian business environment, in order to increase sustainability scoring methods for SMPs, PROTON for example utilizes the products and processes, predictive models and optimization technique (PROTON Annual Report 2011).

In line with these current business needs, the development and the number of lean improvement programmed is a proven approach in order to improve the firms' efficiency and competitiveness for success in the manufacturing industry (Nordin et al. 2010; Habidin and Yusof 2012). In this study, SMPs is an important role in manufacturing industry especially in Malaysian automotive industry. According to PROTON Way, the Malaysian automotive industry itself is moving forward towards preparing lean implementation such as high level performance, product quality improvement, lower cost of production, market price; maximize customer satisfaction, elimination of waste and defects, and strengthening relationships with suppliers (PROTON Annual Report 2011).

The purpose of this research study is to examine the sustainable manufacturing practices in Malaysian automotive industry by using confirmatory factor analysis.

Literature review

Overview on sustainable manufacturing practices (SMPs)

The sustainability or sustainable development in manufacturing and services has attracted the attention from various business practitioners and several research projects and many documents related to them have been published. Indeed, the theory and practices of sustainability within manufacturing has become a critical issue in dynamic business development (Jayal et al. 2010; Gunasekaran and Spalanzani 2011; Despeisse et al. 2012; Gond et al. 2012).

Many organizations all over the world have taken an opportunity to implement sustainable practices in term of competitive positioning (Pretorius et al. 2003), customer relationship and product quality (Szekely and Knirsch 2005; Hansson and Klefsjo 2008), environmental management and supply chains management (Kleindorfer and Saad 2005; Duflou et al. 2012), environmental costs (Ambe 2009), operational practices (PROTON Annual Report 2011), strategic plan and action (Gunasekaran and Spalanzani 2011), material selection (Mayyas et al. 2012; Ullah et al. 2013), and continuous growth and expansion (Nagel and Tomiyama 2004; Yuan et al. 2012).

In short, it is clear that all these long-term benefits also directly influence the sustainability of an organization's success. When sustainability has been successfully carried out, it offers a new strategic approach to increase effectiveness and efficiency in business performance.

Definitions of SMPs

As an early point, it is important to understand there is no single definition for sustainability, perhaps because it is a process or journey, rather than a state or endpoint. Therefore, the term of sustainability or sustainable development is difficult to define and context dependant (Millar and Russell 2011).

Similar to the term sustainable development practices, many different terminologies have tried to determine the definition of SMPs. Some of the different terminologies include best manufacturing practices (Ulusoy and Ikiz 2001), cleaner production (Jackson 2002), green manufacturing (Rusinko 2007; Hu 2012), sustainable production (Rahimifard and Clegg 2007; Jafartayari 2010; Nabhani et al. 2013), sustainability of manufacturing and services (Gunasekaran and Spalanzani 2011; Amirmostofian et al. 2014; Roy et al. 2014; Teli et al. 2014a).

A general definition of sustainable manufacturing is provided by The United States Department of Commerce as sustainability in the creation of manufactured products. According to Gunasekaran and Spalanzani (2011) and Habidin et al. (2013), SMPs refer to a business model which creates value consistent with the long term preservation and conservation and also enhancement of triple bottom line. This is because SMPs concept provides a continuous improvement program structure which is focused on improvement of risk, cost, waste, material and energy efficiency, and environmentally friendly products and services (Joseph and Taplin 2011; Molamohamadi and Ismail, 2013). Taking into account, the previous SMPs concept by Garetti and Taisch (2012) defined SMPs as an ability to use the raw material effectively, by creating new product through current technology, regulatory measures and coherent social behaviours with respect to the triple bottom line performance (Voudourisa et al. 2012).

With reference to previous studies above, it can be concluded that SMPs refer to the ability to maintain the performance at an optimal level of production in the long-term by using the available resources effectively. Furthermore, during the practical implementation, the result of each sustainability assessment must be related to the situation, while also attempting to sustain the holistic objective given by the above-mentioned definition.

SMPs and current trends

This section reviews related research and current trends of SMPs implementation. Theoretically, sustainable manufacturing integrates operational continuous improvements which reduce the environmental impacts of manufacturing process. This effort requires a shift in the awareness and understanding of manufacturing process and adopts a holistic approach to business management. Comprehensive research has been conducted by Jafartayari (2010) to investigate the level of awareness and the degree of practice by using the 6Rs concept (reduce, reuse, recycle, recover, redesign and remanufacture) proposed by Jawahir et al. (2006). The survey results showed that the level of awareness on sustainable manufacturing has a direct relationship with the SMPs.

The importance of high-quality manufacturing in establishing and sustaining a global competitive position in manufacturing practices lead to improved triple bottom line performance. Gimenez et al. (2012) explored the impact of sustainable manufacturing on each dimension of the triple bottom line through internal and external sustainable programmes. Generally, SMP concept provides a continuous improvement program structure which is focused on improvement of business risk, waste generation, material and energy efficiency, and create an environmentally friendly products and services (Szekely and Knirsch 2005). From the environmental sustainability perspective, manufacturing practices should result in minimum waste and energy usage (Jayal et al. 2010; Gunasekaran and Spalanzani 2011), and avoid regulatory entanglements (Fairfield et al. 2011). On the whole, the current trend of implementing SMPs will surely be one of the most important issues to address in the big picture of sustainable development

Table 1 Summary of past-related research for SMPs

Focus Area	Finding(s)	Authors
SMPs	• SMPs focused on improvement of business risk, waste generation, material and energy efficiency, and create an environmentally friendly products and services.	Gunasekaran and Spalanzani (2011)
	• SMPs as an ability to use the raw material effectively, by creating new product through current technology, regulatory measures and coherent social behaviours with respect to the triple bottom line performance.	Garetti and Taisch (2012)
	• SMPs include the relevant environmental issues, green manufacturing, life cycle aspects, and in advancing manufacturing operations and processes.	Rosen and Kishawy (2012)
	• SMPs focused on environmental, economic, and social sustainability as important drivers for sustainable manufacturing.	Vinodh and Joy (2012)
	• SMPs emphasize to minimize the manufacturing operations in order to optimize production efficiency of firms.	Nordin et al. (2014)

especially in Malaysian automotive industry. Table 1 shows the summary of past-related research for SMPs.

SMPs construct

The development of SMPs constructs depends on four elements namely Manufacturing Processes (MP), Supply Chain Management (SCM), Social Responsibility (SR), and Environment Management (EM) which have adopted the conceptual framework proposed by Millar and Russell (2011) and Fairfield et al. (2011).

Manufacturing processes (MP)

Changes in supply and demand, increasing competition from quicker rivals and fewer resources are sending clear signals that the organization need to change their manufacturing strategies. New business models and complex relationships are becoming the norm, so they are looking for strongest strategies to streamline operations, boost productivity and maintain quality (Teli et al. 2014b). Thus, one of the important aspects to implement SMP is the early consideration of MP in terms of: (i) efficient resource (Karim et al. 2008; Loskyll et al. 2012; Duflou et al. 2012); (ii) management control (John and Ngoasong 2008); and (iii) products quality (Afazov 2013). It recognized that improvements in the MP would be giving the positive impact on working practices and productivity to automotive manufacturing industry.

Schoenherr (2011) hypothesised the impact of EN on plant performance. Environmental initiatives considered include ISO 14000 certification, pollution prevention, recycling of materials, and waste reduction (Hibadullah et al. 2013); plant performance is assessed with the dimensions of the four competitive capabilities of quality, delivery, flexibility, and cost. Yang et al. (2011) suggest that prior lean manufacturing experiences are positively related to EN practices. In doing so, environmental sustainability requires improved resources use-productivity (Seliger et al. 2008; Zubir et al. 2012) in order to reduce natural resource material as well as consequent waste and pollutant outputs.

Supply chain management (SCM)

Supply chain management (SCM) became a focus for researchers when more and more organizations are making use of SCM to improve their organizational performance.

This strategic viewpoint has adopted in automotive industry (Humphrey 2003; Olugu and Wong 2012). Most of the previous articles argued that SCM provides a strategic link between supply chain relationship quality and cooperative strategy (Power and Sohal 2001; Su et al. 2008), supply chain integration and customer delivery performance (Boon-itt and Wong 2011); product quality and business performance (Agus 2011), and information manufacturing sharing and supply chain performance. The authors look at how align this CSF with company goals and how an organization might use SCM measure to drill down and locate a manufacturing problem that is causing the organization to miss its sustainability target.

Social responsibility (SR)

Social responsibility (SR) practices are considered as significant and necessary issue in order for the business society, considered as the most responsible actor for socio-economic and environmental problems, to provide efficient solutions for the more sustainable future (Iamandi 2007; Basu and Palazzo 2008; Sava et al. 2011; Fuzi et al. 2012; Habidin et al. 2014). A growing body of academic literature on SR is showing the best quality (McWilliams and Siegel 2001) record of SR positively influences organizational performance in various industries and for the automotive industry (Fray 2007; Shinkle and Spencer 2012; Loureiro et al. 2012; Zadek et al. 2012).

Environment management (EM)

Indeed many academics and practitioners have highlighted the modelling, simulation and practices of environment management are very important aspect in variety of industrial applications across the countries around the world. Normally, waste reduction in manufacturing contributes to EM through greater efficiency in the use of production resources (McCann and Holt 2010) and the adoption of cleaning practices and improved organization of the productive environment (King and Lenox 2001; Moldan et al. 2012). For automotive industry itself, most of automotive manufacturer have implement the EM on operational performance (Jabbour et al. 2012). In doing so, EM will be measured by doing this study, particularly in automotive industry.

Methods

Questionnaire development

In the SMPs questionnaires, questions were divided into various sections, starting with some general information (type of product, quality award, etc.) and then focusing on MP, SCM, SR, and EM. To evaluate the content validity, questionnaires were e-mailed and reviewed by sustainability manufacturing expert from local and international academic and practitioner. The questionnaires were modified based on their comments.

Questionnaires were administered simultaneously in each PROTON vendor by researchers. We were mailed or e-mailed to the Executive Manager, Director of Operations/Manufacturing or the person with the equivalent position in the organization. The Executive Manager, Director of Operations/Manufacturing is the best suited to self-report the decisions made regarding the manufacturing practice and the results of the quality program implement.

The questionnaire utilized the 7-point Likert scale, representing a range from very low = 1 to very high = 7 which has been used by management researchers before (Shaw et al. 2012; Latreille et al. 2012).

Population and sampling of a study

The research on SMPs constructs would be conducted using quantitative survey for Malaysian automotive industry. The population of this research comprised automotive suppliers in Malaysia and samples were selected from the list of Proton Vendor Association (PVA) and Kelab Vendor PERODUA (KVP). The suppliers supply electrical, electronic, metal, plastic, rubber, and other automotive parts.

All the data would be analyzed using SEM technique. The methodology for assessing an appropriate sample size requirement can be a difficult question to answer in SEM-based studies. Therefore, it requires large sample sizes between 100 to 200, but not more than 400, due to the large number of estimates (Hair et al. 1998). Bacon (1997) had reviewed SEM applications from other publication and pointed out that SEM typically uses 200–400 cases to fit models within 10–15 observed variables. Another study done by Christopher (2010) found that the average total for sample size of SEM is 50 % of the minimum measurement needed. For this research purpose, 400 questionnaires were distributed to Malaysian automotive industry and 227 completed from received giving the response rate of 56.75 %.

Reliability and validity

For this research proposed, Cronbach's Alpha Coefficient was used to access reliability for each construct. According to the classical citation on Cronbach's alpha, Cronbach (1951) has identified thousands of investigation report based on measurement which is concerned with the accuracy or dependability. A reliability coefficient demonstrates whether the test designer was correct in expecting a certain collection of items to yield interpretable statements about individual differences (Kelley 1942; Ihantola and Kihn 2011). Table 2 show the reliability analysis for SMPs constructs.

By referring to Table 2, due to the fact that all constructs have the reliability (alpha value) greater than 0.8, thus it shows that all items from statistics construct are reliable and should not be dropped for further analysis, which is the inferential analysis.

In quantitative research, validity is one of the most essential manifestations of research method. Validity refers to the extent to which the number obtained truly reflects what the user intended to measure. Particularly in quantitative accounting research, Ryan et al. (2002) raise the ultimate question on whether the researcher can draw valid conclusions from the research design. Buckley et al. (1976) seem to suggest they already

Table 2 Results of reliability analysis for SMPs constructs

Constructs/Measures	Number of items	Alpha (α) value	Item for deletion	Alpha (α) if items is deleted
SMPs				
MP	7	0.902	None	0.902
SCM	3	0.811	None	0.811
SR	3	0.753	None	0.753
EM	4	0.833	None	0.833

believe that validity is not a belonging of the measure, but instead refers to the reliability of the conclusions which are drawn from the measure.

For this research purpose, the validation of the instrument was concluded in the following procedures: (i) content validity and (ii) construct validity. The first validation was done through literature review on the concept of SMPs which are related to the nature of quality improvement shown by Malaysian automotive industry. Additionally, in order to check and measure the validity, the constructs had been divided into specific measurement items and reviewed by the panel of experts comprising academicians and industrial experts.

In addition, EFA and CFA were adapted in order to meet the requirement of specifying the measurement model and identifying the indicator measure for each construct. Both of them have similar functions but the scope of measurement framework is different. EFA framework is to delete the suggested items and place where the item should be added (Karuppusami and Gandhinathan 2006). In contrast, CFA framework is used to test and examine the extent to which the data set can fit the measurement structure. In this research, both of them were conducted on SMPs indicator. The next stage in this analysis was to test the measurement model, in which the SMPs indicators were tested based on confirmatory factor analysis.

Statistical analysis

The publishers among the international and local e-resources have seen a substantial increase in the number of submissions and publications using Structural Equation Modelling (SEM) techniques. SEM is defined as very powerful multivariate analysis technique which includes specialized versions of a number of other analysis methods as particular cases (Shah and Goldstein 2006). By using the combination of statistical data and qualitative causal assumptions, SEM technique was adopted in attempt to test and estimate causal relations.

In this research, AMOS version 20.0 had been selected to perform the SEM analysis. AMOS uses the basic overall goodness-of-fit measures to assess the compatibility of the purpose model according to six criteria: Chi-square over degree of freedom ($\chi 2$ /df), goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Comparative Fit Indexes (CFI), Tucker Lewis Index (TLI), and Root Mean Square Error Approximation (RMSEA).

Results and discussion

EFA on SMPs constructs

EFA for 17 items of SMPs was done on random sample ($n = 227$) of Malaysian automotive suppliers to determine the basic details of each SMP construct namely: MP, SCM, SR, and EM. As shown in Table 3, Kaiser-Meyer-Olkin (KMO) measurement showed the sampling adequacy as 0.89. According to Kaiser (1974), recommended accepting values >0.5 and described values between 0.5–0.7 = mediocre, 0.7–0.8 = good, 0.8–0.9 = great and >0.9 = superb.

Table 3 KMO and Bartlett's test for SMPs constructs

Kaiser-Meyer-Olkin measure of sampling adequacy		0.891
Bartlett's Test of Sphericity	Approx. Chi-Square	1974.965
	df	136
	Sig.	0.000

Similarly, Bartlett's test of sphericity was significant at (p <0.001), indicating sufficient correlation among items to proceed with the analysis.

Initial solution results

Four factors in initial solution had larger Eigen values (1.038) as described in Table 4. All factors contributed 67.866 % from the total variance which is sufficient for further analysis which requires at least 50 % (Chinna 2009; Zakuan 2009). This shows that four latent influences are associated. Meanwhile, similar to the initial solution, the last column of cumulative percentage indicated that the variance explained by extraction solution was also 67.866 %. Hence, four factors have been acceptable because the total variance was more than 50 % which is 67.866 %.

Rotated component matrix results

In EFA, discriminant validity is only shown if the item loading is high towards the related factor when compared to other factors. At least 0.5 loads for each item on respective factor are considered sufficient for the factor (Ngai et al. 2004). This type of results assists the researcher to identify the items which correlate the highest to one factor and on the lowest remaining factor.

The first factor was made up of the six items from building MP including MP1, MP2, MP4, MP5, MP6, MP7, and MP9. Item MP3, MP8, and MP10 were suggested to be deleted. The next factor was classified as SCM and SR with three items namely SCM1, SCM2, and SCM3 for SCM and SR1, SR2, and SR3 for SR. No item was suggested to be removed. Finally, the fourth factor was grouped as EM and consisted of four items namely EM1, EM2, EM3, and EM4. Therefore, 17 items of SMPs of each SMP constructs in this study.

Confirmatory factor analysis (CFA)

CFA was to test the measurement model and to examine whether the data set fit the measurement structure. In this study, CFA was conducted based on four factors (MP, SCM, SR, and EM).

SMPs constructs with four factors

SMPs model with four factors (MP, SCM, SR, and EM) manifested an adequate fit outcome as shown in Fig. 1. $\chi 2$ statistics was 183.87 (degree of freedom = 113, $p < 0.001$), with a ratio of $\chi 2/\text{df}$ value being 1.63 less than 2.00 thus exhibiting a good fit. GFI was 0.916 and AGFI was 0.887 which was moderate fit. CFI was 0.97 and the TLI was 0.96. Excellent fit is greater than 0.90. The value of RMSEA was 0.053, less than 0.08 which displayed a good fit. All canonical correlation (RC) showed values of less than 1.00 signalling that discriminant validity was tested and acceptable. At factor loading, the

Table 4 Results of total variance explained for SMPs constructs

Factors	Number of items	First Eigen value	Percentage of variance explained
		1.038	67.866
MP	7		
SCM	3		
SR	3		
EM	4		

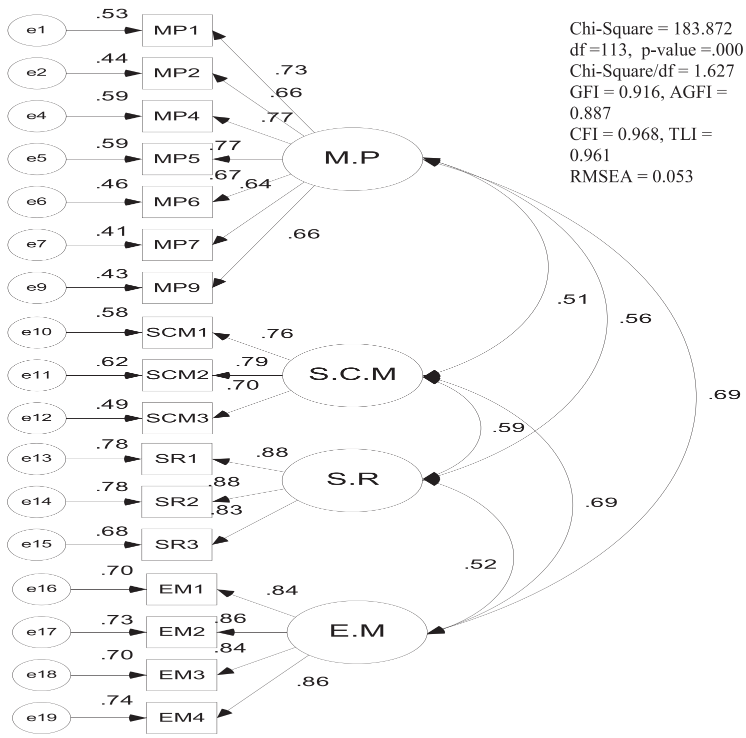

Fig. 1 Modified SMPs model: output path diagram with four factors

standard coefficient estimated was good as it surpassed the accepted level of 0.30 with *p*-value <0.001 as presented in Fig. 1.

Based on the results of CFA, the four constructs of SMPs are significant variables. Through the measurement model of SMPs constructs, four factors of model analysis as measurement model for SMPs constructs demonstrated good fit and proved that this model is valid and reliable for Malaysian automotive industry. This model was supported by Hair et al. (Hair et al. 2006) mentioned that goodness of fit measures is important to look before continuing the analysis of factor in CFA. This method is carried out to determine which factors are most significant. Therefore, these four constructs as applicable for measuring the SMPs implementation in Malaysian automotive industry.

Practical implications

The SMPs model has been developed and verified, and the four constructs are found to be applicable for Malaysian automotive suppliers. This study will assist academicians and practitioners in order to increase their knowledge and comprehension of SMPs implementation which can assist the automotive industry to improve the company's performance. This research extends to explore in the area of automotive performance especially in the Malaysian region. Therefore, this research analyses the SMPs by using the confirmatory factor analysis not only for theoretical aspects but also from empirical validation.

Conclusions

By using the SEM technique, four success factors for SMPs constructs were developed and verified. The significant items were maintained to create an instrument of latent constructs and measurement items after conducting the validity and reliability tests. As a confirmation, it was found that these automotive manufacturers are interested and involved in sustainability, and most of them see a clear alignment between sustainability and their overall business strategy. The limitations of this study is only able to focus on automotive industry in Malaysia due to the lack of time, financial, knowledge, skills, and technical support. These limitations of the literature may offer new dimensions of research area. Considering current limitations of the literature, this research has given space, opportunities, and recommendations for future researchers to subsequently explore this area in greater detail in their pursuit of organizational excellence through SMPs. As noted before, this research makes a contribution of filling the existing gaps in research in Malaysian automotive industry. For future research, it is suggested that future researchers must be able to prepare themselves with various supports before conducting the final research.

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
NFH, AFMZ, NMF, NAML, MNAA designed this study, analyzed the data, and wrote the paper. The authors declare that all authors have read and approved the final manuscript.

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References

Afazov, SM. (2013). Modeling and simulation of manufacturing process chains. *CIRP Journal of Manufacturing Science and Technology, 6*(1), 70–77.

Agus, A. (2011). The structural influence of supply chain management on product quality and business performance. *International Journal of Trade, Economics and Finance, 2*(4), 269–275.

Ambe, CM. (2009). *Linkages of sustainability and environmental management accounting* (*Proceedings of the 2nd South African-German Dialogue on Science for Sustainability*, 26th -27th October). Pretoria: CSIR ICC.

Amirmostofian, A, Reunanen, M, & Uusitalo, T. (2014). An analysis of the role of risk management in sustainability reporting - a case study of 27 European manufacturing companies. *International Journal of Sustainable Manufacturing, 3*(2), 116–142.

Bacon, LD. (1997). *Using AMOS for SEM in market research*. USA: Lynd Bacon and Associates Ltd., and SPSS Inc.

Barnes, J, Kaplinsky, R, & Morris, M. (2004). Industrial policy in developing economies: developing dynamic comparative advantage in the South African automobile sector. *Competition and Change, 8*(2), 153–72.

Basu, K, & Palazzo, G. (2008). Corporate social responsibility: a process model of sense making. *Academy of management review, 33*(1), 122–136.

Boon-itt, S, & Wong, CY. (2011). The moderating effects of technological and demand uncertainties on the relationship between supply chain integration and customer delivery performance. *International Journal of Physical Distribution & Logistics Management, 41*(3), 253–276.

Buckley, JW, Buckley, MH, & Chiang, H. (1976). *Research methodology and business decisions*. New York: NAA.

Chinna, K. (2009). *Structural Equation Modeling Using AMOS*. Kuala Lumpur: Malaysia.

Christopher, WJ. (2010). Lower bounds on sample size in structural equation modelling. *Electronic Commerce Research and Applications, 9*(6), 476–487.

Cronbach, LJ. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3), 297–334.

Despeisse, M, Mbaye, F, Ball, PD, & Levers, A. (2012). The emergence of sustainable manufacturing practices. *Production Planning and Control: The Management of Operations, 23*(5), 354–376.

Duflou, JR, Sutherland, JW, Dornfeld, D, Herrmann, C, Jeswiet, J, Kara, S, Hauschild, M, & Kellens, K. (2012). Towards energy and resource efficient manufacturing: a processes and systems approach. *CIRP Annals-Manufacturing Technology, 61*(2), 587–609.

Fairfield, K, Harmon, J, & Behson, S. (2011). Influences of the organizational implementation of sustainability: an integrative model. *Organization Management Journal, 8*(1), 1541–6518.

Fray, AM. (2007). Ethical behaviour and social responsibility in organizations: process and evaluation. *Management Decision, 45*(1), 76–88.

Fuzi, NM, Habidin, NF, Desa, AFNC, Hibadullah, SN, & Zamri, FIM. (2012). Corporate social responsibility practices (CSR) and CSR performance in Malaysian automotive industry. *International Journal of Accounting and Financial Reporting, 2*(2), 268–277.

Garetti, M, & Taisch, M. (2012). Sustainable manufacturing: trends and research challenges. *Production Planning and Control: The Management of Operations, 23*(2–3), 83–104.

Gimenez, C, Sierra, V, & Rodon, J. (2012). Sustainable operation: Their impact on the triple bottom line. *International Journal Production Economics, 140*(1), 149–159.

Gond, J, Grubnic, S, Herzig, C, & Moon, J. (2012). Configuring management control systems: Theorizing the integration of strategy and sustainability. *Management Accounting Research, 23*(3), 205–223.

Gunasekaran, A, & Spalanzani, A. (2011). Sustainability of manufacturing and services: investigation for research and applications. *International Journal Production Economics, 140*(1), 35–47.

Habidin, NF, Fuzi, NM, Desa, AFNC, Hibadullah, SN, & Zamri, FIM. (2014). ISO 26000 efforts and corporate social responsibility performance in Malaysian automotive industry. *International Journal of Business Excellence, 7*(4), 515–529.

Habidin, NF, & Yusof, SM. (2012). Relationship between lean six sigma, environmental management system, and organizational performance in Malaysian automotive industry. *International Journal of Automotive Technology, 13*(7), 1119–1125.

Habidin, NF, Zubir, AFM, Conding, J, Jaya, NASL, & Hashim, S. (2013). Sustainable manufacturing practices, sustaining lean improvement and sustainable performance in Malaysian automotive industry. *World Review of Entrepreneurship, Management and Sustainable Development, 9*(4), 444–459.

Hair, FJ, Black, WC, Babin, BJ, Anderson, RE, & Tatham, RL. (2006). *Multivariate data analysis* (6th ed.).

Hair, JF, Anderson, RE, Tatham, R, & Black, W. (1998). *Multivariate data analysis with readings*. New Jersey: Prentice Hall, Englewood Cliffs.

Hibadullah SN, Habidin NF, Zamri F, Fuzi IM, Desa NM, A FNC. (2013). The integrated between lean manufacturing practices and ISO 14001 efforts in Malaysian automotive industry. *Journal of Applied Science and Research*, 1(1), 17–27.

Hansson, J, & Klefsjo, B. (2008). Sustaining quality management implementation in small organisations – experiences from quality award recipients. *International Journal of Management Practice, 3*(1), 31–50.

Hu, G. (2012). Market and social welfare analysis for hybrid sustainable manufacturing industry. *International Journal of Sustainable Manufacturing, 2*(4), 338–355.

Humphrey, J. (2003). Globalization and supply chain networks: the auto industry in Brazil and India. *Global Networks, 3*(2), 121–41.

Iamandi, I. (2007). Corporate social responsibility and social responsiveness in a global business environment a comparative theoretical approach. *Romanian Economic Journal, 10*(23), 3–18.

Ihantola, E, & Kihn, L. (2011). Threats to validity and reliability in mixed methods accounting research. *Qualitative Research in Accounting and Management, 8*(1), 39–58.

Jabbour, CJC, Silva, EM, Paiva, EL, & Santos, FCA. (2012). Environmental management in Brazil: is it a completely competitive priority? *Journal of Cleaner Production, 21*(1), 11–22.

Jackson, T. (2002). *Industrial ecology and cleaner production: a handbook of industrial ecology*. UK: Edward Elgar Publication Limited.

Jafartayari, S. (2010). *Awareness of sustainable manufacturing practices in Malaysia manufacturers*. Universiti Teknologi Malaysia: Master of Engineering (Industrial Engineering).

Jawahir, IS, Joshi, K, Venkatachalam, A, & Jaafar, IH. (2006). *A new methodology for transforming 3R concept into 6R concept for improved product sustainability* (Proceedings of the IV Global Conference on Sustainable Product Development and Life Cycle Engineering).

Jayal, AD, Badurdeen, F, Dillon, OW, Jr, & Jawahir, IS. (2010). Sustainable manufacturing: modelling and optimization challenges at the product, process and system levels. *CIRP Journal of Manufacturing Science and Technology, 2*(3), 144–152.

John, AO, & Ngoasong, LN. (2008). *Budgetary and management control process in a manufacturing organization*. Malardalen University: Master Thesis.

Joseph, C, & Taplin, R. (2011). The measurement of sustainability disclosure: Abundance versus occurrence. *Account Forum, 35*(1), 19–31.

Kaiser, HF. (1974). An index of factorial simplicity. *Psychometrika*, 39, 31–36.

Karim, MA, Smith, AJR, Halgamuge, SK, & Islam, MM. (2008). A comparative study of manufacturing practices and performance variables. *International Journal Production Economics, 112*(2), 841–859.

Karuppusami, G, & Gandhinathan, R. (2006). Pareto analysis of critical success factors of total quality management: a literature review and analysis. *The Total Quality Management Magazine, 18*(4), 372–385.

Kelley, TL. (1942). The reliability coefficient. *Psychometrical, 7*(2), 75–83.

King, AA, & Lenox, MJ. (2001). Lean and green? an empirical examination of the relationship between lean production and environmental performance. *Production and Operations Management, 10*(3), 244–256.

Kleindorfer, PR, & Saad, GT. (2005). Managing disruption risks in supply chains. *Prod Oper Manag, 14*(1), 53–68.

Laosirihongthong, T, & Dangayach, GS. (2005). A comparative study of implementation of manufacturing strategies in Thailand and Indian automotive manufacturing companies. *Journal of Manufacturing Systems, 24*(2), 131–143.

Latreille, PL, Buscha, F, & Anna, CA. (2012). International trends and developments in alternative dispute resolution: are you experienced? SME use of and attitudes towards workplace mediation. *The International Journal of Human Resource Management, 23*(3), 590–606.

Loskyll, M, Heck, I, Schlick, J, & Schwarz, M. (2012). Context-based orchestration for control of resource-efficient manufacturing processes. *Future Internet, 4*(3), 737–761.

Loureiro, SMC, Sardinha, IMD, & Reijnders, L. (2012). The effect of corporate social responsibility on consumer satisfaction and perceived value: the case of the automobile industry sector in Portugal. *Journal of Cleaner Production, 37*, 1–7.

Malaysian-German Chamber of Commerce and Industry (MGCC). (2012). Market watch 2012, the Malaysian automotive and supplier industry. http://www.malaysia.ahk.de/fileadmin/ahk_malaysia/Market_reports_2012/. Accessed 20 November 2014.

Mayyas, A, Qattawi, A, Omar, M, & Shan, D. (2012). Design for sustainability in automotive industry: a comprehensive review. *Renewable and Sustainable Energy Reviews, 16*(4), 1845–1862.

McCann, JT, & Holt, RA. (2010). Servant and sustainable leadership: an analysis in the manufacturing environment. *International Journal of Management Practice, 4*(2), 134–148.

McWilliams, A, & Siegel, D. (2001). Corporate social responsibility: a theory of the firm perspective. *The Academic of Management Review, 26*(1), 117–127.

Millar, HH, & Russell, SN. (2011). The adoption of sustainable manufacturing practices in the Caribbean. *Business Strategy and Environment, 20*(8), 512–526.

Molamohamadi, Z, & Ismail, N. (2013). Developing a new scheme for sustainable manufacturing. *International Journal of Materials, Mechanics and Manufacturing, 1*(1), 1–5.

Moldan, B, Janouskova, S, & Hak, T. (2012). How to understand and measure environmental sustainability: indicators and targets. *Ecological Indicators, 17*, 4–13.

Nabhani, F, Mckie, M, & Hodgson, S. (2013). A case study on a sustainable alternative to the landfill disposal of spent foundry sand. *International Journal of Sustainable Manufacturing, 3*(1), 1–19.

Nagel, MH, & Tomiyama, T. (2004). *Intelligent sustainable manufacturing systems, management of the linkage between sustainability and intelligence, an overview*. the Netherlands: IEEE International Conference on Systems, Man and Cybernetics.

Ngai, EWT, Cheng, TCE, & Ho, SSM. (2004). Critical success factors of web-based supply chain management system using exploratory factor analysis. *Production, Planning and Control, 5*(6), 622–630.

Nordin, N, Ashari, H, & Rajemi, MF. (2014). A case study of sustainable manufacturing practices. *Journal of Advanced Management Science, 2*(1), 12–16.

Nordin, N, Deros, BM, & Wahab, DA. (2010). Relationship between organizational change and lean manufacturing implementation in Malaysian automotive industry. (*The 11th Asia Pacific Industrial Engineering and Management Systems Conference and the 14th Asia Pacific Regional Meeting* of International Foundation for Production Research).

Olugu, EU, & Wong, KY. (2012). An expert fuzzy rule-based system for closed-loop supply chain performance assessment in the automotive industry. *Expert Systems with Applications, 39*(1), 375–384.

Power, DJ, & Sohal, AS. (2001). CSF in agile supply chain management: an empirical study. *International Journal of Physical Distribution and Logistics Management, 31*(4), 247–265.

Pretorius, IM, Visser, SS, & Bibbey, FJ. (2003). Contemporary management accounting for the sustainable competitiveness of the South African motor manufacturing industry. *Meditari Accountancy Research, 11*(1), 95–112.

PROTON Annual Report. (2011). *PROTON Annual Report*. http://ir.chartnexus.com/proton/flash/ar_2011/index.html. Accessed 25 December 2014.

Rahimifard, S, & Clegg, AJ. (2007). Aspects of sustainable design and manufacture. *International Journal of Production Research, 45*(18–19), 4013–4019.

Rosen, MA, & Kishawy, HA. (2012). Sustainable manufacturing and design: Concepts, practices and needs. *Sustainability, 4*(12), 154–174.

Roy, V, Baysal, MM, Sarigecili, MI, Shuaib, M, Badurdeen, F, & Jawahir, IS. (2014). Development of the integrated product information model for product sustainability assessment. *International Journal of Sustainable Manufacturing, 3*(2), 156–169.

Rusinko, CA. (2007). Green manufacturing: an evaluation of environmentally sustainable manufacturing practices and their impact on competitive outcomes. *Engineering Management, IEEE Transactions on Engineering Management, 54*(3), 445–454.

Ryan, B, Scapens, RW, & Theobald, M. (2002). *Research method and methodology in finance and accounting*. London: Thomson.

Sava, T, Moisa, C, & Langa, C. (2011). Study on promoting social responsibility by SMEs in order to ensure sustainable performance. *Economy Transdisciplinarity Cognition, 14*(1), 73–80.

Schoenherr, T. (2011). The role of environmental management in sustainable business development: A multicounty investigation. *International Journal Production Economics*, 140(1), 116–128.

Seliger, G, Kim, HJ, Kernbaum, S, Zettl, M. (2008). Approaches to sustainability manufacturing. *International Journal of Sustainable Manufacturing*, 1(1/2), 58–77.

Shah, R, & Goldstein, SM. (2006). Use of structural equation modeling in operations management research: looking back and forward. *Journal of Operations Management, 24*, 148–169.

Shaw, JD, Park, TY, & Kim, E. (2012). A resource-based perspective on human capital losses. HRM investments, and organizational performance. *Strategic Management Journal, 34*, 572–589.

Shinkle, GA, & Spencer, JW. (2012). The social construction of global corporate citizenship: sustainability reports of automotive corporations. *Journal of World Business, 47*(1), 123–133.

Su, Q, Song, Y, Li, Z, & Dang, J. (2008). The impact of supply chain relationship quality on cooperative strategy. *Journal of Purchasing and Supply Management, 14*(4), 263–272.

Szekely, F, & Knirsch, M. (2005). Responsible leadership and corporate social responsibility: metrics for sustainable performance. *European Management Journal, 23*(6), 628–647.

Teli, SN, Majali, VS, Bhushi, UM, & Gaikward, VG. (2014a). Assessment of supplier quality cost in automobile industry. *International Journal of Quality Engineering and Techhnology, 4*(1), 1–20.

Teli, SN, Majali, VS, Bhushi, UM, & Surange, VG. (2014b). Impact of poor quality cost in automobile industry. *International Journal of Quality Engineering and Technology, 4*(1), 21–41.

Ullah, AMMS, Hashimoto, H, Kabo, A, & Tamali, J. (2013). Sustainability analysis of rapid prototyping: material/resource and process perspectives. *International Journal of Sustainable Manufacturing, 3*(1), 20–36.

Ulusoy, G, & Ikiz, I. (2001). Benchmarking best manufacturing practices, a study into four sectors of Turkish industry. *International Journal of Operations and Production Management, 21*(7), 1020–1043.

United States: Prentice Hall

Vinodh, S, & Joy, D. (2012). Structural equation modeling of sustainable manufacturing practices. *Clean Technologies and Environmental Policy, 14*(1), 79–84.

Voudourisa, I, Lioukasa, S, Iatrellib, M, & Caloghiroub, Y. (2012). Effectiveness of technology investment: impact of internal technological capability, networking and investment's strategic importance. *Technovation, 32*(6), 400–414.

Yang, MG, Hong, P, Modi, SB. (2011). Impact of lean manufacturing and environmental management on business performance: an empirical study of manufacturing firms. *International Journal of Production Economics*, 129(2), 251–261.

Yuan, C, Zhai, Q, & Domfeld, D. (2012). A three dimensional system approach for environmentally sustainable manufacturing. *CIRP Annals-Manufacturing Technology, 61*(1), 39–42.

Zadek, S, Forstater, M, & Yu, K. (2012). Corporate responsibility and sustainable economic development in China: applications for business. National Chamber Foundation.

Zakuan, NM. (2009). *Structural analysis of total quality management, ISO/TS 16949 and organizational performance in Malaysian and Thailand automotive industry*. Universiti Teknologi Malaysia, Malaysia: Doctoral of Engineering.

Zubir, AFM, Habidin, NF, Conding, J, Jaya, NASL, & Hashim, S. (2012). The development of sustainable manufacturing practices and sustainable performance in Malaysian automotive industry. *Journal of Economics and Sustainable Development, 3*(7), 130–138.