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# Sustainable manufacturing drivers and firm performance: Moderating effect of firm size

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ABSTRACT

The growing concern of the negative impact of manufacturing activities on triple bottom line has led researchers to embark on sustainable manufacturing study. Empirical evidence from previous research has demonstrated that sustainable manufacturing is a comprehensive strategy to minimize the negative impact to the environment. However, study on the link of sustainable manufacturing drivers and firm performance in Malaysia remains inconclusive, thus need for further investigation. Moreover, the possible explanation for the inconsistent relationship is due to the difference in firm size of manufacturing firms involved in sustainable manufacturing activities. This research intends to investigate the moderating effect of firm size on the relationship between SM drivers and firm performance. Data was collected from selected industries in manufacturing firms in Malaysia and analyzed with SEM-AMOS. The empirical result revealed that firm size moderates the relationship between market forces and strategic leadership with firm performance. The relationships between policy and regulation and resource availability with firm performance were not significantly moderated by firm size. The results indicate that larger firms will experience a higher rate of firm performance as having advantage of firm size compared to smaller firms.

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## 1. Introduction

At present, the manufacturing industry has been shifting rapidly due to the increasing awareness of sustainable manufacturing activities. Thus, manufacturing firms have implemented various sustainable practices to reduce carbon footprint, remain competitive and as an answer to the global concern of environmental degradation. Some of the practices are known as Environmentally Conscious Manufacturing (Despeisse et al., 2012), Lean Manufacturing (Vienazindiene and Ciarniene, 2013) and Green Manufacturing (Rusinko, 2007; Rehman and Shrivastava, 2013). The emergence of sustainable manufacturing practice (SMP) concept in manufacturing industry is the consequences of global development of sustainable practices, aimed at minimising the negative impacts of manufacturing activities to the environment. In Malaysia, large manufacturing firms are inclined towards practicing sustainable manufacturing as to keep up with the rapid pace and changes in the respective industry. The implementation of sustainable manufacturing does not only focus on large manufacturing firms but also on the entire supply chain within the industry to ensure that SMP is a success. In particular, the practices towards striving for manufacturing sustainability are uncommon in small and medium-sized enterprises (SMEs) compared to large firms (Jamian et al., 2012), particularly in developing countries. As a result of the relatively recent man-made disasters, the public has observed an increasing number of large and small firms demonstrating their individual efforts to become more environment-friendly.

Successful implementation of SMP may be influenced by size of the manufacturing firm as either an advantage in term of resources or benefits by inducing the cost of saving. More dedication will be given by firms to the implementation of SEMP if it is perceived as beneficial and will thus improve performance achievement. However, firms will not be dedicated to the implementation of environmental initiative if it is not perceived to yield better firm performance. These two different contentions on the perception of sustainable

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environmental manufacturing practices of firms require the need for investigating the influence of perceived benefits on the relationship between SMP and the performance of firms

## 2. Literature review

### 2.1. Sustainable manufacturing drivers and firm performance

The purpose of SM is to create manufacturing products using processes that minimise the negative environmental impacts, conserve energy and natural resources, safe for employees, communities, consumers and sound economically as outlined definition from the USDC (2012). In this regard, SM companies must observe the manufacturing activities that are balancing the TBL requirements as to meet the ultimate goals of sustainable development, due to SM has been regularly promoted as a mean of improving business competitiveness (Soosay et al., 2016; Vinodh and Joy, 2012).

The SM emphasises the concept of sustainability whereby manufacturing firms need to adopt SMP, which in turn will enhance the firm performance, at the same time preserve TBL dimensions. This study utilised the TBL approach to measures firm performance in a manufacturing firm and explored the relationship between the SM drivers leading to a firm performance from the perspective of RBV.

#### 2.1.1. Policy and regulation and firm performance

Over the past few years, governments, industry and third-party organisations have extended and put a considerable amount of effort to grow and encourage firms' participation in environmental initiatives (Darnall and Sides, 2008). Policy and regulation are among the prominent efforts that were available in the previous literatures which serves as a guideline and rules pertinent to the manufacturing activities. Such policy and regulations were endorsed to control the potential harms caused by the manufacturing operations. In this regard, the manufacturing firms are enforced to operate under the required rules (Lai and Wong, 2012).

Earlier researchers discussed both positive and adverse argument on the relationship between policy and regulation and firm performance. There is an argument that increased environmental policy and regulation could lead to unproductive investments, higher costs and a possible loss of competitive advantage (Walley and Whitehead, 1994). On the other hand, stringent environmental regulations presented firms with opportunities for improved efficiency (Porter and Linde, 1995) and international competitive advantage (Porter, 1991). Latest empirical findings suggested that policy and regulation have positive influence leading to sustainability practices further enhanced the performance of manufacturing firm. A study by Lai and Wong (2012) found that an improvement in green logistic management and firm performance was a result of severe regulatory pressure. Other researchers revealed that compliances towards environmental regulations contribute to increasing image and effectiveness of green practices operation at a manufacturing firm's level (Rashid et al., 2014).

The increasing laws and regulations, coupled with the recognition that developing more eco-friendly manufacturing operations is "the right thing to do" have put sustainability at or near the top of most manufacturing firms' agendas and enhanced the firm performance (Heilala et al., 2008). In line with this, Smith and Perks (2010) suggested that manufacturing firm can improve its competitiveness and firm performance through improvements in environmental performance as a result of compliance with environmental policy and regulation, at the same time address the environmental concern of customers and reduce the environmental impact of their products and services. Therefore, it is argued that policies and regulations serve as guidelines and encouragement for firms to ensure successful yet effective execution of SMP activities, hence greater enhancement in firm performance. Accordingly, the following hypothesis is predicted:

H1a: Policy and regulation are positively related to firm performance

#### 2.1.2. Strategic leadership and firm performance

Strategic leadership from both government and industry are essential to ensure the involvement at all levels in manufacturing activities which surrounding with risk and opportunities (MSA, 2009). In this study, strategic leadership refers to the ability of top management to influence employees to make voluntary decisions that enhance the long-term sustainability of the firms whereas at the same time preserving firm's short-term economic stability (Rowe, 2001). Top management commitment is the participation and the provision of the senior management of firms (Khalil et al., 2011) towards adding value and shaping the SMP implemented by firm (Drumwright, 1994). The commitment of senior management in strategic leadership roles is crucial as it influences the decision making associated with sustainability initiatives in manufacturing firms due to the decision process by either the values of powerful individuals or the organisation's values rather than a widely applied decision rule (Bansal and Roth, 2000; Jabar et al., 2011).

Various authors acknowledge that greater firm performance as a result of having responsible leaders who can strategically build strong organisational capacity with fully committed to the sustainability efforts (Székely and Knirsch, 2005; Ireland and Hitt, 1999; Avery and Bergsteiner, 2011). Such studies depicted that effective strategic leadership practices can help firms enhance

performance, while competing in turbulent and unpredictable environments (Ireland and Hitt, 1999). For example, engaging in valuable strategies and ethical issues particularly sustainability practices is one of the necessary capabilities for effective strategic leadership in the new competitive setting as outlined by Hitt et al. (2010). Consequently, it is posited that strategic leadership roles played by top management as a hypothesis.

H1b: Strategic leadership is positively related to firm performance

### 2.1.3. Resource availability and firm performance

The RBV theory assumes that tangible and intangible resources utilisation influences the performance of firms. Manufacturing firms are regularly adopting SMP when there are available resources to engage with those sustainability efforts (Abu et al., 2014). A study in manufacturing firms by Sheikh et al. (2016) found strong evidence and revealed that human resource practices such as training provided, compensation and promotion do affect the performance of firms. Furthermore, well-trained workforces who perform exhibit strong skills and capable of accomplishing expected duties effectively while strategically inspired managers will lead the firms to achieve anticipated objectives and strong performance (Sunday and Somoye, 2011).

Similarly, Thomas et al. (2012) found an evidence of financial improvement of manufacturing firms resulted in the willingness of the firms to develop the necessary internally skills to become expertly self-sufficient in precision manufacturing technology and systems operation (Murad and Thomson, 2011). The study also highlighted that the availability of appropriate and modern manufacturing equipment, adequate financial resources, flexible, intelligent and skilled personnel became survival elements towards SM companies (Abu et al., 2015; Thomas et al., 2012). Before this, active link on the relationship between firm's capability and cost and profit performance has also been discovered by Bharadwaj (2000) and available resources are the significant predictors of firm environmental performance (Elsayed, 2006). Hence, it is suggested that fully utilisation of tangible and intangible resources accessible in manufacturing firms will contribute to a better firm performance.

H1c: Resource availability is positively related to firm performance

### 2.1.4. Market forces and firm performance

Empirical findings suggested that the elements of market forces such as customers, competitors and suppliers make the manufacturing firms to consider sustainable more seriously (Seidel et al., 2006), drives firms' sustainability efforts and plays a significant influence on firm performance (Schrettle et al., 2011). Manufacturing firms in the high competitive industry and market uncertainty need to alert and stay reacted with the market forces in changing environmental challenge (Jabar, 2012). It is because market forces shape the competitive setting and build the environment which individual manufacturing firms are visible to and influence cooperative efforts and green practices (Rehman and Shrivastava, 2013).

Manufacturing firms experienced greater firm performance due to successfully adjusted and responses toward market forces. Environmental responsibility firms can foster a positive corporate image and provide points of differentiation to the firm (Bhaskaran et al., 2006). Moreover, market demands for sustainable practices include product stewardship, enhanced public image and potential to expand customer base and competitive advantage (Rusinko, 2007). Also, customers are better informed and more aware of the environmental and human health impacts of the products they purchase and increasing environmentally conscious which prefers eco-labelled products, and the most crucial thing is that the performance of retailers on environmental issues influences the buying decision of the customers (Matapoulos and Bourlakis, 2010). These pressures make manufacturing firms to utilise an environmental manufacturing operation and improve their performance. On the other hand, the involvement with environmentally cautious suppliers can have positive feedback on the firm's credibility in managing eco-sustainability and firm's competition might exert power in that competitors' values, and norms which may be perceived superior with regards to eco-sustainability firm (Schrettle et al., 2011). Based on the arguments, it is hypothesised that:

H1d: Market forces are positively related to firm performance

## 2.2. Moderating role of firm size on sustainable manufacturing drivers and firm performance

From the perspective of resource-based, firm size is a crucial resource leading to high profitability (Grant, 1991) and also affect firm's performance as well as sustainability. Firm size describes firm resources endowment generally has important link to the planning due the formulation and implementation of strategies require commitment of scarce resources (Temtime, 2003). Since the implementation of SMP is mostly rely on planning behaviour of the firms which in turn affected by firm size, the need to explore the moderating effect of firm size is apparent. Large firms play a crucial role to support economic and nation development due to have superior advantage in term of resources and capabilities as compared to small firms (Murad et al., 2015).

Moreover, large firms are also gain competitiveness in manufacture green product, market strategy as well commercialisation (Teece et

al., 1997). Large size firms generally enhances their ability to invest in advanced technologies and to enjoy economies of scale and scope (Chan, 2005). Relatively, small firms possess specialties of creating wealth through new economic activity by integrates bundle of resources to exploit marketplace opportunities (Chelliah et al., 2010).

Numerous studies have been conducted to reveal the moderator effect of firm size among large and small firm. Previous strategy research revealed that large firm size led to more sophisticated strategic planning process and enhance firm's effectiveness (Chan, 2005). On the other hand, firm size weakly moderates the manufacturing technology performance relationship, due to their superior resource base, larger firms are able to use technology more effectively (Swamidass and Kotha, 1998).

Similarly, size has moderating factor for internationalization only for smaller firms. It only gives huge impact when relatively smaller firms acquire international knowledge and experience (Chelliah et al., 2010). Furthermore, study by Chan (2005) discovered significant moderating influences of firm size on the process of achieving company-wide ecological sustainability.

The decision to adopt SMP is not an easy choice as manufacturing firms are essentially required to assign certain specific resources to ensure constant improvement towards sustainability initiatives. The barriers to adopting sustainable efforts are closely related to lack of resource and capability (Ebinger et al., 2006), which is much related to financial resources to support sustainable initiatives and weakness of a company's business culture (Daily and Huang, 2001).

Furthermore, Eltayeb and Zailani (2009) argued that the major constraint for developing countries to engage in green initiatives is due to the lack of capabilities in term of non-availability of cost-effective technologies. Thus, firm size plays important roles as it indicates the capacity of a firm to pursue SMP, in line with the argument of successful implementation of green initiatives depend heavily on several factors particularly financial or budget allocation.

Basically, small firms have capabilities of technology information networking skit, however, weak in knowledge and business management skills. Bowen (2002) argued that larger firms are more committed to voluntary green initiatives because they have more resources and more visible to the society. Moreover, a significant variance in performance of small, medium and large firms was discovered in the study of Chen (2008) and Gimenez et al. (2012). Thus, the following hypothesis is anticipated as below:

H2: Firm size significantly moderates the relationship between SM drivers and firm performance, whereby larger firms perform better than smaller firms

## 3. Methodology

### 3.1. Population and sampling

Population of this study comes from manufacturing firms that are registered with Federation of Malaysian Manufacturer (FMM, 2012). Sample has been randomly selected among three sub-industries known as Electric and Electronic (EandE), Machinery and Equipment (MandE) and Engineering Supporting using stratified random sampling technique. The key respondents for this study were directors, managers, executives and engineers from manufacturing firms that have extensive experience and knowledge on SMP's implementation. This study utilized both mail and online survey questionnaire for data collection. Out of 2000 distributed questionnaire, data collection from both methods gathered 352 returned surveys (17.6% response rate) and only 323 surveys (16.2% response rate) were found usable for this study.

### 3.2. Instrumentation

The survey instrument was developed based on the combination of existing, validated measurements from an extensive review of literature and the newly developed, modified measurements from previous studies. The seven-point Likert scale was employed throughout the instrument, with the use of the terms 'strongly disagree' and 'strongly agree' corresponding to each item. Specifically, items used in measuring policy and regulation (Natarajan et al., 2012; USDC, 2012), strategic leadership items (Gimenez et al., 2012; Seidel et al., 2006; Thomas et al., 2012; Nidumolu et al., 2009), resource availability items (Gunasekaran and Spalanzani, 2012; Johansson and Winroth, 2010; Thomas et al., 2012) and market forces items (Rusinko, 2007; Gunasekaran and Gallear, 2012). Additionally, firm performance items measured from triple bottom line perspectives, economic and environmental items (Millar and Russell, 2011) while social items (Park and Pavlovsky, 2010; Fan et al., 2010).

### 3.3. Data analysis techniques

This study employed both IBM-SPSS version 21 and Structural Equation Modeling (SEM) AMOS 18 to analyze the data. The preliminary analysis, such as the detection and treatment of missing data, normality assumption and Exploratory Factor Analysis (EFA) was done with SPSS. The hypotheses were tested with SEM-AMOS which provides a series of advantages relative to other methodological approaches.

Specifically, the moderator variable has been analyzed using latest approach known as Stat Wiki tools through integrating two computer programs namely AMOS software and Excel spread sheet in evaluating the presence of moderating effects. The core idea of this approach follows Sharma et al.

(1981) techniques in utilising Z-scores to determine the moderator variables. Thus, this research followed the steps suggested by Gaskin (2012) as in Stat Wiki website and downloaded the Stat Tools package in measuring the AMOS output. As mentioned in the procedure, three important outputs from AMOS outputs need to be transferred into Excel spread sheet, namely Stat Tools package to generate Z values. This technique is much better in reducing the time to calculate the difference of chi square for each unconstraint path, and also in reducing mistakes done in the calculation process.

## 4. Results and discussion

As predicted in Hypothesis 1a, policy and regulation is positively related to firm performance, and this relationship is found to be significant (β = 0.10, p < 0.001). Hypothesis 1b indicates a positive relationship between strategic leadership and firm performance, but it is not significant (β = 0.06, p = 0.45). For hypothesis 1c, resource availability positively leads to firm performance (β = 0.02, p = 0.82) hence the hypothesis is also not supported. Meanwhile, the result supports Hypothesis 1d, proving that the market force has a positive impact on firm performance with (β = 0.15, p < 0.001). Summary of hypothesis results for sustainable manufacturing drivers and firm performance depicted as in Table 1.

Z-score data for firm size as moderator between small (N = 167) and large (N = 156) firms generated from Stat Tools package is shown in Table 2. The analysis indicates a consistent result for all of the prediction and criterions path, except for the relationship for market forces and strategic leadership with firm performance. Results from the analysis draw a conclusion that relationship between market forces and strategic leadership is moderated by firm size because the z-scores value is significant at 3.154*** and -1.954*. Furthermore, the GOF indicators such as GFI = 0.80, TLI = 0.90, NFI = 0.89, CFI = 0.90 and RMSEA = 0.06 provide an acceptable value for model fit.

**Table 1:** Hypotheses and results

| Predictor Variables | Criterion Variables | *β* | T-Value | P-Value | Hypothesis | Result |
|---|---|---|---|---|---|---|
| Policy and regulation | FP | 0.10 | 1.34 | *** | H1a | Supported |
| Strategic leadership | FP | 0.06 | 0.78 | 0.45 | H1b | Not Supported |
| Resource availability | FP | 0.02 | 0.22 | 0.82 | H1c | Not Supported |
| Market forces | FP | 0.15 | 2.64 | *** | H1d | Supported |

Note: FP = Firm performance

**Table 2:** Results of hypothesis testing for moderation of firm size

| Predictor | Criterion | Small Firm | | Large Firm | | |
|---|---|---|---|---|---|---|
| | | Estimate | p | Estimate | p | Z-Score |
| FP | Market forces | 0.554 | 0.000 | 0.010 | 0.885 | -4.496*** |
| FP | Strategic leadership | -0.151 | 0.237 | 0.208 | 0.060 | 2.126* |
| FP | Resources availability | 0.030 | 0.792 | -0.203 | 0.340 | -0.964 |
| FP | Policy and regulation | 0.031 | 0.752 | 0.189 | 0.105 | 1.032 |

Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value 0.10, FP = firm performance

The analysis conducted confirmed that firm size significantly moderates the relationship between market forces and strategic leadership with firm performance. Therefore, hypothesis H2 is accepted. This study contributes to enrich the knowledge on firm size as moderator in market forces model and applying it to firm performance. As suggested by Darnall et al. (2010), researchers evaluating firms and the natural environment should be cautious about associating market pressure directly with firms' environmental strategies. Rather, the relationship between stakeholder pressures and environmental strategy tends to vary with size. This is because smaller firms may attach less importance to international customers, suppliers and rivals than large firms (Buysse and Verbeke, 2003). Zailani et al. (2012) also found that most of certified companies in Malaysia being forces by customers to implement environmental practices which in turn influence firm performance. In case of strategic leadership, large firms may have advantage over small firms in term of establish environmental strategy and designated activities as well management review (Daily and Huang, 2001).

## 5. Conclusion

In summary, firm size plays important role in moderating the relationship between firm's strategic resources and firm performance. Large firms contribute to a significant role by supported economic development due to able to sustain the competitive advantage through specific resources and capabilities available as compared to small firms. Hence, large firms are most likely to perform better due to they gain competitiveness in manufacture green product, marketing strategy as well product commercialisation (Teece et al., 1997). Moreover, large size firms may be able to enhance their capability to involve and invest in high technologies and machineries, thus enjoy economies of scale and market share.

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