An empirical investigation of green initiatives and environmental sustainability for manufacturing SMEs

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Abstract

Purpose – The purpose of this paper is to study the extent of green initiatives within manufacturing SMEs, as well as the mediating effect of the owners/managers intention toward green and moderating effect of green technology adoption in building environmental sustainability in the context of the Malaysian manufacturing SMEs.
Design/methodology/approach – Data were collected through a survey questionnaire responded by 260 Malaysian manufacturing SMEs. The relationships proposed in the developed conceptual framework were represented through three hypotheses: there is a significant relationship between green initiatives and environmental sustainability (*H1*); intention toward green mediates the relationship between green initiatives and environmental sustainability (*H2*); and green technology adoption moderates the relationship between intention toward green and environmental sustainability (*H3*). SEM-AMOS nested model comparisons and mediating and moderating analyses were used to test the hypotheses.
Findings – This is the first research toward the green initiatives framework for the manufacturing SMEs. Till date, no framework is available which could guide researchers and practitioners of this high impact on the environment industry. The findings revealed that energy management, water conservation and waste management are related to environmental sustainability. On mediation analysis, it confirms that owners/managers intention toward green fully mediates the association of green initiatives and environmental sustainability. Finally, the moderation analysis revealed that green technology adoption does not have an influence on manufacturing SMEs environmental sustainability.
Practical implications – This study is expected to help both researchers and practitioners in terms of manufacturing and other industries who are serious toward environmental sustainability implementation and are looking for an appropriate mechanism. It offers a generalized environmental sustainability implementation linking SMEs owners/managers, green practices, green technology policy, process management and supply chain management.
Originality/value – This study is among the very first environmental sustainability implementation research works conducted in the Malaysian manufacturing sector, particularly, in relation to the green initiatives and "four pillars" of green technology policy that manufacturing SMEs in this country need to adopt to make their environmental sustainability a solid competitive vehicle for their development. The results have broader implications for all manufacturing SMEs, particularly in developing economies where the growth of manufacturing and the development of integrated environmental sustainability are key stages in economic development.

Keywords Environmental management, Green manufacturing, Manufacturing management, Small- and medium-sized enterprises

Paper type Research paper

1. Introduction

Small and Medium Enterprises (SMEs) are acknowledged as the backbone to any economy as they are significant contributors to employment and economic growth. Generally, SMEs account for the largest proportion of established businesses in most of the developing nations (Saleh and Ndubisi, 2006). Malaysia is one of the developing countries whose economy mainly depends on the SME sector (Tehrani and Manap, 2014). It was reported

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that SMEs in Malaysia attribute to approximately 97.3 percent of businesses established and 35.9 percent of the country's gross domestic product is contributed by SMEs. SMEs also contribute 21.7 percent to the country's total exports and 67.0 percent to total employment in the country (Department of Statistics Malaysia, 2015). Since 2005, the growth of SMEs has surpassed other industries with an overall added value of 29.3 percent in 2005 to 43.9 in 2016 (Department of Statistics Malaysia, 2017).

On the other hand, concerns on environmental issues have steadily increased (Bonney and Jaber, 2011) and sustainable green practices are no more a buzzword, which used to be heard in boardrooms and corporate meetings, rather has become a challenging reality. Today, issues such as ways to deal with greenhouse gases emitted into the atmosphere, decreasing the content of dangerous gases in the air and managing used resources and waste products which are dumped into landfills and left to decay are seen (Bonney and Jaber, 2011). Conversely, sustainable green practices embrace the use of eco-friendly design, raw materials, packaging, distribution and even re-use/retreatment after the useful life of a product. It describes practices throughout the manufacturing process that are not harmful to the environment. These practices include recycling, conserving the environment, managing and reducing wastes, complying with regulation and controlling pollution (Jabbour *et al.*, 2015; Neves *et al.*, 2014).

The green practices of manufacturing SMEs in Malaysia warrant investigation because this sector is predicted to have a collective impact on the environment and could outweigh the combined environmental impact of large companies (Hillary, 2000). At any given time, SMEs are crucially important to the health and stability of the global economy and their environmental performance can affect its financial performance (El Saadany *et al.*, 2011). Broadly, sustainable green practices and their outcomes have been addressed from various perspectives, ranging from the application of green technologies as a mean to gain competitive advantage (Leonidou *et al.*, 2013) to the perception of environmental regulation as a driver for innovation (Hillary, 2000), improvement of the competitive position (Porter and Van der Linde, 1995; Marchi *et al.*, 2013) and minimizing the operating cost, the carbon footprint and delivery time in supply chain distribution network (Bortolini *et al.*, 2016). In support, some studies on the development of green issues over time focused on specific industrial sectors (Bansal, 2002; Lee and Rhee, 2007), multi-sectorial large companies (Dahlmann and Brammer, 2011), and supply chain distribution network (Bortolini *et al.*, 2016), addressing the advancement of environmental proactivity. Despite this, attention has normally been devoted to large firms, and thus disregarding the development in manufacturing SMEs, which, after all, constitute the backbones in many economies. On account of this, the impact of manufacturing SMEs on the natural environment remains significant, and therefore this study was conducted.

The remaining sections include the following: Section 2 which focuses on the importance of the study and the research gap. Section 3 revises the literature of sustainable green practices in SME and development of hypotheses for green initiatives, intention toward green and green technology adoption. Section 4 discusses research methodology and covers data collection, while Section 5 covers data analysis and results. Section 6 discusses the finding and implication of the study. Finally, the last section concludes this paper with final remarks and indicates directions for future research.

2. Importance of the study in Malaysia and global contexts

According to the declaration made during the UN Climate Change Conference (UNFCCC, 2015), efforts should be made to conserve the environment. Preventive endeavors should not only be limited to the efforts within the manufacturing industry, but also should involve efforts that take into account organizational, social and economic aspects. These days in Malaysia, according to Gill *et al.* (2018), Masud *et al.* (2017) and Noh (2016), six identifiable

changes are happening, which are as follows: first, the new business models through e-commerce and m-commerce to reach buyers, suppliers and even end customers facilitated by mobile telephony, internet-based support tools and integrated databases-based technologies offering quality products and services; second, the fluctuating demand from domestic customers for a greater variety of products in different packaging formats with high quality, shorter delivery windows, competitive prices and best after-sales services; third, the rapid changes in oil prices resulting recession in financial and capital markets around the world influencing Malaysian markets; fourth, the rapid increase of performance index of Industrial Production Malaysia and sales value in manufacturing sector from 4.3 to 7.3 percent; fifth, rise in the family income and spending potentials of middle-income group fueling growth for luxuries of life; and sixth, enhanced and government supportive focus on "Good Sales Tax" through direct investments in infrastructure and residential projects to sustain urban growth such as East Coast Railway, Kuantan Malaysia and China Industrial Park, Alibaba Digital Free Trade Zone Regional Hub and other redevelopment activities in cities.

These changes encourage developed countries to use Malaysia as their manufacturing platform rather than just marketing their products here. This creates a significant impact in the market and the manufacturing industry (Tseng *et al.*, 2013; Alon *et al.*, 2016). These changes drive researchers and industry players to introduce novel, standalone or hybrid techno-managerial solutions such as sustainable green practices to understand sustainability agenda. However, there are limited studies in manufacturing industry context of the developing country. This study poses a significance as it is conducted in the Malaysian context, which is a developing diversity with great geographical spread and heterogeneity. In this regard, research confronts different challenges as it is a strong emergent market that provides an important sourcing base for the world due to its size, population and low-cost manufacturing capacity (Castells, 2014; Alvstam *et al.*, 2016). There are very limited amount of studies that focused on the operational and managerial insights and identified the green initiatives encouraging the application of sustainable green practices or hindering the effective implementation of the framework. Thus, this paper examines the relationship between green initiatives for manufacturing SMEs and sustainable green practices and it is believed that the findings can also be used in other economies and process industry setups.

2.1 Research gaps

Some of the world's emerging economies have not realised the full advantage of sustainable green practices, despite many industrial perspectives which posit that the adoption and implementation of sustainable green practices are relatively straightforward (Sarkis, 2001). It is argued that in developing countries, more efforts should be done to match the attention on sustainable green practices adoption in developed countries (Epstein and Buhovac, 2014). Studies like Mansouri *et al.* (2015) have notioned that there is still limited multi-objective decision-making studies in comparison to single objective analyses on areas like sustainable green practices. Furthermore, studies suggested that researchers should pay more attention to multi-objective functions instead of single objective ones as real world problems often have multiple, instead of single objective (Hwang and Masud, 2012; Govindan *et al.*, 2015).

Thus, this paper's objective is to identify the implementation of sustainable green practices among SME owners/managers by illustrating the role played by green initiative and the adoption of green technology. The understanding of these two aspects is imperative in examining the real life issues faced by organizations in implementing sustainable green practice. Thus, based on the framework and by understanding the theory of green initiatives and green technology adoption, the present study seeks to identify and analyze the green initiatives and green technology adoption in contributing to the successful implementation of sustainable green practices from the Malaysian manufacturing SMEs perspective.

3. Environmental sustainability in SMEs

Environmental sustainability is defined as the actions and/or projects done by people that can be accomplished or done continuously or for long periods of time with little or no adverse impact to the environment (Hart, 1995). This is the typical "mantra" of various environmental groups all over the world not only to protect resources for the present generation but also to preserve them for future generations. In addition, over the past two decades, it has come to the attention of environmental researchers that SMEs are significant contributors to the overall emissions and releases which are negatively affecting the environment (Parker *et al.*, 2009; Waters, 2010; Yacob *et al.*, 2013). As a result, SMEs are recent subjects of great interest from researchers and government agencies (Gadenne *et al.*, 2009) with the development of policies, tools and programs to assist them in reducing their environmental footprint (Waters, 2010). A study by Tilley (1999) found that there are limited studies that have explored small firms' response to environmental challenges and so far, no literature with any real analytical inquiry is available. Over the years, there are relatively few new papers that have explored the issues, except for those who focused on large corporation. Besides that, there are few that have acknowledged the presence of SME, reported the developments in legislation and illustrated that SMEs are more prone to stakeholders pressure and legislative requirements (Esty and Winston, 2006).

Even though prone to stakeholder pressure, Esty and Winston (2009) suggested that SMEs are in a better position to implement green practices because they are more flexible and open to change due to their focus on innovation. Additionally, they are open to niche markets in response to emerging demands from new stakeholders. In this regard, empirical research has shown mixed or even conflicting findings although most past studies argued that good environmental performance could lead to better financial performance (Dixon-Fowler *et al.*, 2013), highlighting the complexity in linking the two (López-Gamero *et al.*, 2009). In response to those who are convinced that SMEs do not leave a large impact by adopting green practices, Tilley (1999) pointed out that the large number of SMEs in most economies results in a significant cumulative environmental impact.

A groundwork done in 1995 approximated that collectively SMEs make up for 70 percent of industrial pollution and generated between 50 and 80 percent of waste (Hillary, 2000). In this regard, Aragón-Correa *et al.* (2008) mentioned that different solutions should be taken by SMEs to transform their environmental behaviors due to the different organizational focus. Furthermore, Williams and Schaefer (2013) found a disparity between the SMEs aspiration to become more sustainable and their real actions to achieve this aspiration. This predominantly depends on several factors such as training and education. According to Tilley (1999), small firms should allow drastic changes such as fighting resistant forces like the lack of eco-literacy and strengthening their driving forces, effective research and a combination of both to encourage a strategic respond in order to allow them to change their environmental behavior needs. Another study by Cassells and Lewis (2011) suggested that owners/managers are personally motivated to act on green issues; however, they lack the business resources to adopt long-term changes. It was also found that SMEs are more likely to implement environmental policies and management system, employ specialist staff and channel their values and expectations to their partners. In this light, there are less evidence that size influences the uptake of activities in waste reduction and the adoption of greener design practices. A study by Vernon *et al.* (2003) found that SMEs think protecting the environment is the responsibility of the local authority and planners, rather than theirs. This illustrates the barriers of sustainability in SMEs, and Oxborrow and Brindley (2013) argued that green technology could be a main driver for competition. On a similar vein, Van Hemel and Cramer (2002) posited that "environmental aspects can function as impetus for product innovation."

Despite acknowledging that SMEs are critical players toward achieving sustainable development, they are not adequately equipped with the knowledge and tools required to

implement green practices in their operations (Burke and Gaughran, 2007). Furthermore, the ever-increasing consumer demand for environmentally friendly goods and services as well as the escalating costs of waste disposal have all triggered environment-related business opportunities for the SMEs. In light of this, SMEs that respond to market forces and are innovative enough to reduce waste generation and environmental cost will have a competitive advantage over the market.

3.1 Green initiatives

In the last years, increasing consciousness in sustainable manufacturing and rising attention to the definition of eco-friendly assignment rules have led to preliminary set of contributions and best practices (Bortolini *et al.*, 2017). There is a large and diverse literature on the implementation of green initiative among business operators which indicates green initiatives are often initialized by changing business strategies (Sharma and Vredenburg, 1998) that drive the innovation and product design (Porter and Van der Linde, 1995) as well the revamp of production processes (Hart, 1995; Pujari, 2006), innovation of production technologies (Van Hoek, 2001) which comprise of waste generation reduction activities, minimizing the by-products of wastes, reducing energy consumption, increasing the conservation of water, enhancing the use of materials, decreasing occupational health and safety hazards as well as improving general workplace safety (Lin and Huang, 2012). In these contexts, the implementation of green initiatives normally requires firms to find and use supporting strategies and increase resources (Handfield *et al.*, 2005).

Broadly, manufacturer classified green initiatives into four categories: pollution prevention approaches aiming at compliance; pollution prevention approach aiming at competitive advantage; end-of-pipe or pollution control measures; and value-seeking strategies. The structures that differentiate them are in the resources required for implementation (Russo and Fouts, 1997), technologies employed (Klassen and McLaughlin, 1996), the range of stakeholders involved (Buysse and Verbeke, 2003), and the time frame of benefits realization (Cordeiro and Sarkis, 1997).

All these categories are associated with investments and aim at major modifications of processes and products in the quest of reducing or eliminating pollution at sources and at the end of manufacturing processes (Hart, 1995; Russo and Fouts, 1997). In addition, according to Zotter (2004), this execution also includes multiple processes or phases of the product life cycle and cannot be decoupled from the production system. Positive changes in the environmental practices of large companies are occurring and larger companies commonly employ dedicated human resources personal or Safety officers to plan and control environmental issues with the environmental management system (EMS) standard of procedures. However, the high cost of EMS implementation, which varies from company to company (Balta and Woodside, 1999), resulted in the redistribution of resources away from investment in more environmentally friendly practices.

Therefore, to reduce the investment cost, modification of products or processes and potential financial savings and opportunities that go with many other activities, most of the manufacturing SMEs opted for "one to one initiatives" to control harmful effects of business activities to the environment and the negative impact of human activities. Therefore, this study selected energy management, water conservation and waste management as the green initiatives for hypotheses development and testing. Furthermore, most of the environmental research has been carried out in larger organizations settings (Redmond *et al.*, 2008) and this study contributes to the growing body of knowledge within manufacturing SMEs by considering energy management, water conservation and waste management as the significant areas of green initiatives.

3.1.1 Energy management. The role of energy management has largely increased in industries but there is little effort to implement energy management in SMEs due to the lack of resources and expertise (Rizzo and Fulford, 2012). In the meantime, electricity consumption is an important ratio of cost for production activities as oil price influences the tariff of electricity. Over the years, there is a gradual increase of fuel prices, and based on forecast, the oil price will increase from $57 per barrel in 2017 to $79 by 2019, which shows a 43 percent increase (Tseng *et al.*, 2016). Consequently, many SMEs are operating on thin margins, causing them to be susceptible to cost increases. The forecasted hike of electricity tariff over the next few years shows that SMEs must increase their efficiency in using of energy and find how to limit and manage the amount of money they spent on electricity due to the limited capital they have on their disposal to spend on upgrading facilities or equipment to improve energy efficiency (Choong *et al.*, 2012). With changing times, there is a need for SMEs to improve their sustainable green practices, market image and market presence position, and all of this could be done by identifying and adopting the energy efficiency measures systematically to achieve green sustainability.

3.1.2 Water conservation. Apart of energy management, most manufacturing processes require water as part of their input and individual processes. Kenny *et al.* (2009) noticed that water conservation is a major issue in industrial activities and many SMEs do not pay much attention to water conservation in their manufacturing processes. Furthermore, Frost (2011) echoed Kenny *et al.* (2009)'s view that without careful water conservation, avoidable water wastage occurs in many SMEs. Furthermore, it is found that many SME owners/managers ignore the adoption of water minimization practices mainly due to the heavy financial commitment that may be required (Bay and Rasmussen, 2011). However, what many businesses fail to realize is that in addressing water issues that are deemed financially burdensome, they stand to gain in terms of efficiency and profitability in the longer term (Hoskinson, 2010; Mofokeng, 2013). Therefore, water conservation has been considered as one of the significant areas of green initiatives in SMEs and should be implemented, managed and controlled by a systematic method to achieve green sustainability.

3.1.3 Waste management. On the other hand, it is said that the problem of waste management arises due to the unsustainable consumption in the operation processes (Tchobanoglous, 2009) and many SMEs are facing difficulties in disposing the waste from their production process. Most of the SMEs have traditionally managed their waste products by discharging them into the environment without preceding treatment (Patrício *et al.*, 2015; Winfrey and Tilley, 2016), resulting in an increase of pollution and negative environmental impacts. Waste management performance of SMEs is neither recognized nor evaluated as most of the environmental research concentrates on large firms. In addition, Weerasiri and Zhengang (2012) reported that the level of recognition placed on the importance of waste management in SMEs is considerably low and more emphasis should be given to enhance the waste management agenda in SMEs. Therefore, waste management has been considered as one of the significant areas of green initiatives in SMEs and should be implemented, managed and controlled by a systematic method to achieve green sustainability.

In this regards, the present study intends to investigate the perspectives and explanatory situation adjoining the three green initiatives (energy management, water conservation and waste management) toward sustainable green practices in manufacturing SMEs and this leads to the development of first hypothesis:

H1. Green initiatives have a significant relationship with sustainable green practices.

H1a. Energy management has a significant relationship with sustainable green practices.

H1b. Water conservation has a significant relationship with sustainable green practices.

H1c. Waste management has a significant relationship with sustainable green practices.

3.2 Intention toward green

Intention toward green in manufacturing SMEs is relatively under researched (Aykol and Leonidou, 2015) and in most cases, the negative attitudes and personal values of SME owners/managers to the environment are the determinant of poor environmental performance (Stevens *et al.*, 2012; Renwick *et al.*, 2013). In spite of this, SMEs are generally much less likely to be involved in environmental improvement activities compared to large firms, adopt a written environmental policy, and adopt a formal environmental management standard or to take an environmental audit (Ervin *et al.*, 2013). In fact, it is common that not all owners/managers have the same eagerness in undertaking certain actions toward pursuing a specific purpose. This is because behavior is dependent on several internal variables as stated by Eagly and Johnson (1990), whereby a key part of the research on the entrepreneurial phenomenon is formed based on individual's psychological attitude. Nevertheless, Ajzen (1991) explained that the subject's attitude toward that behavior is dependent on the intention of performing a behavior. Therefore, owners/managers are much more likely to perform a certain behavior due to their favorable attitude and this approach is better than others that are based on traits or demographic aspects (Krueger *et al.*, 2000). Besides, Pascual *et al.* (2009) and Cordano *et al.* (2010) also strongly supported the fact that once firms consider green issues as a part of their intention, environmental impact becomes an argument and this allows for increasing efficiency and reducing environmental asymmetry. Accordingly, this study intends to examine the decisions made by manufacturing SMEs owners/managers toward sustainable green practices that are interceded by the intention toward green and this leads to the development of second hypothesis:

H2. There is a positive relationship between intention toward green and sustainable green practices.

H3. There is a positive relationship between energy management and intention toward green.

H4. There is a positive relationship between water conservation and intention toward green.

H5. There is a positive relationship between waste management and intention toward green.

H6. Intention toward green mediates the relationship between green initiatives (waste management, water conservation and energy management) and the sustainable green practices.

3.3 Green technology adoption

Green technology adoption comprises of adopting novel or improved processes, techniques and systems to decrease harmful effects of business activities to the environment and the negative impact of human activities (Ministry of Energy, Green Technology and Water, 2009). In addition, this process can be viewed as an innovation process which involves the use of new technical and administrative knowledge which could be adopted by the SMEs too. Several multinational companies in Malaysia (e.g. freescale semiconductor (integrated circuit), first Solar Malaysia (solar cells and modules), SCG industries (wafer fabrication), and flextronics technologies (computer, telecommunication and networking products)) adopted green technologies as one of the practical solutions to address the issues of environment and sustainability. Apart of this, studies such as by Henriques and Sadorsky (2007), Lin and Ho (2011) and Rothenberg and Zyglidopoulos (2007) examined environmental issues from the technological perspective and provided an insight on how green technologies could be influenced by certain organizational and environmental factors.

Meanwhile, there is an intensifying debate on the changing nature of learning and knowledge acquisition regarding the adoption of green technology. One point to look into is increasing division between acquired technological and production capabilities (Bell and Pavitt, 1993). Another aspect to consider is the effect of globalization on the knowledge dissemination mechanisms. Archibugi and Petrobelli (2003) asserted that the adoption of technology has little impact on learning *per se*, and urge for policies to become cooperation strategies that focus on technological partnering. Furthermore, Nelson (2007) highlighted the evolving legal environment and the increasing closeness between technological and scientific communities. From these arguments, it can be observed that domestic innovation competences have become imperative for the successful adoption of green technologies among SMEs. Here, there is a link between the acceptance of modern technologies and the development of abilities to further advance their international marketing area (Nelson, 2007). The required competences are also based on the characteristics of the technologies. In general, green technologies in manufacturing are medium/high technologies which involve the foresight processes which reveal a fairly high potential for innovation that caused these green innovations (Lee *et al.*, 2005). In this light, as attaining sustainability is highly difficult, there is an increased awareness on the need to transform the entire industry. Therefore, an understanding of moderating factor of green technology is essential for SME owners/managers in implementing sustainable green practices and this leads to the development of third hypothesis:

H7. Green technology adoption moderates the relationship between intention toward green and sustainable green practices.

4. Materials and methods

This study used a survey to collect categorical data, can be used for the statistical testing of the formulated hypotheses. This method is l due to its advantage as it can collect data from large geographical area with reduced costs (Sekaran, 2003). The following sub-sections describe the data collection method and measures of constructs.

4.1 Data collection method

The sample for this study is Malaysian manufacturing SMEs which comprise of five different subsectors, namely, food and beverage products, apparel and textile, chemical products, electrical and electronics, as well as rubber and plastics. These five subsectors were selected because they have shown the fastest growth rate (D tment of Statistics Malaysia, 2016) and these SMEs have been actively involved in disseminating green practices. The list for sampling was obtained from the Federation of Malaysian Manufacturers (2016) directory and the unit of analysis of this study is the manufacturing SMEs operating in Malaysia.

The target respondents for the survey include the owners/managers, managers, managing directors and head of department in Malaysian manufacturing SMEs. These respondents were selected as they have the first-hand knowledge and information on green issues, green initiatives, and shown progressive environmental performance toward their firms. The survey was in form of a structured mail questionnaire which was addressed to each corresponding respondent in their respective SME. In total, 260 usable responses were received from a total of 893 questionnaire distributed; hence, the effective response rate was 29.1 percent. The sample was estimated to be effective at the 95 percent confidence level with a margin of error of ±7.5 percent.

G*Power version 3.1.9.2 was used to measure the power of the 260 samples with an effect size of 0.15 and statistical significance (a level) of 0.05 (Faul *et al.*, 2009). The analysis yielded a power of 0.928, way beyond 0.80 which illustrates the sample has a satisfactory degree of

power (Chin, 2010). In this regard, the proposed sample size shows the requisite power which could reject the study's null hypotheses (Faul *et al.*, 2009). Meanwhile, a non-response bias was conducted to ensure that the responses received are representative of the sample firms, based on the procedure in Armstrong and Overton (1977). It was assumed that the last 25 percent of responses received were very similar with those given by non-respondents as their replies took the longest time and it took the most effort to obtain their feedback. Hence, the last quartile was compared to the first three quartiles. The study found that at the significance level of 5 percent, no differences between the "early" and "late" respondents were detected and this suggests that non-response bias is not a problem when it comes to data collected in this study.

4.2 Measure of the constructs

The questionnaire was placed into five sections: respondent's personal and company's basic information, green initiatives (energy management, water conservation and waste management), intention toward green, green technology adoption and sustainable green practices. A five-point Likert scale anchored by "strongly disagree" to "strongly agree" for all the items was used. To ensure content validity, questions from previous studies were adapted into the questionnaire as follows.

Energy management was measured with a six-item scale and all six items (e.g. ensures that its activities minimize the amount of energy used, ensures its activities minimize the emissions to air, set measurable targets for reducing energy usage, applies effective strategies for improving energy management, uses high-energy efficient lighting and regularly monitors trends in energy consumption) were developed by Kannan and Boie (2003).

Water conservation was measured with a six-item scale and all six items (e.g. promotes the re-use of water in production process, set measurable targets for reducing water usage, applies effective strategies for improving water conservation, installs water-efficient devices to control water usage, regularly monitors the trends in water usage and ensures its activities minimize the amount of effluent to water) were developed by Kenny *et al.* (2009).

Waste management was measured with a six-item scale and all six items (e.g. ensures that it minimizes the amount of waste resulting from its activities, promotes the recycling of waste by using the most environmentally safe procedures available, set measurable targets for waste reduction, ensures the disposal of hazardous waste appropriately by complying with all existing legislation standards, monitors and records on-site waste disposal and has waste storage facilities that meet environmental requirements) were proposed by Tchobanoglous (2009).

Intention toward green was measured with a six-item scale. Three items (e.g. improve financial performance, benefit from government's incentives and complying with Government's legislation) were developed by Revell *et al.* (2010). Two items (e.g. gain market opportunities and contributes to reducing negative impacts on the environment) were proposed by Cordano *et al.* (2010) and one item (e.g. adhere to Malaysia Green Technology Policy) was constructed by the author.

Green technology adoption was measured with a six-item scale and all six items (e.g. energy efficiency, carbon footprint, green technology financing scheme, green tag, renewable energy and green building) were extracted from Green Technology Malaysia website.

Sustainable green practices were measured with a six-item scale. All six items (e.g. products are designed in a way that minimizes adverse impact on the environment, uses life cycle analysis to assess the environmental impact of the product, carries out environmental audits at regular intervals, requires all suppliers meet certain environmental criteria before sourcing materials from them, has a clear vision of the importance of environmental policies and identifies activities that are environmentally harmful and provides alternatives that minimize these harmful effects) were developed by Kerr (2006).

Before proceeding with each questionnaire, it must be noted that a pretest was conducted on four managers, which helped us to highlight the questions that would not be clearly understood or that could lead to confusion when responding. After the pretest was carried out, alterations were made in several questions in order to ensure that the respondents were able to fully understand them.

The Harman's single factor test was included during the single factor analyses of all the items measured to test the probable common method bias which might be problematic. This is conducted as the data were obtained from a single respondent from a single company. As mentioned by Doty and Glick (1998) and Podsakoff and Organ (1986), common method bias will occur when all the variables load on one, or any factor explains a majority of variance. For this study, five different factors were found through the unrotated factor analysis which used the eigenvalue greater than one criterion. These factors explain 20.82, 16.43, 14.35, 13.82 and 11.24 percent of the data variance, respectively. Therefore, this study can safely conclude that the existence of common method variance in the data will not cause the results to be inflated as the first factor accounted for the data fraction and a single factor did not emerge.

4.3 Analysis technique

The descriptive analysis among the manufacturing SMEs was analyzed using SPSS version 22. Followed on, the two-step approach of Anderson and Gerbing's (1988) was employed to analyze the data with AMOS 22 software. First, confirmatory factor analysis (CFA) was executed to estimate the reliability and validity of measurement model. Recommendations of Bollen (1990) and Hu and Bentler (1999) were applied in selecting and examining multiple indices of the model. This included the χ^2 statistics, root-mean-square error of approximation (RMSEA), composite fit index (CFI), normative fit index (NFI) and Jöreskog's (1993) χ^2/degree of freedom ratio. Second, structural equation modeling (SEM) was carried out to assess the direct relationships among the three green initiatives constructs (energy management, water conservation and waste management) toward sustainable green practices. Third, Structural Nested Model was applied to assess the mediation effect among five constructs in this study. Finally, the moderation influence was examined by using the approach defined by Ping (1996) that draws on the two-step procedure of Anderson and Gerbings (1988).

5. Results

The following section is presented in four parts: descriptive analysis, direct relationship analysis, mediation analysis and moderation analysis which tested hypotheses of the study.

5.1 Descriptive analysis for demographic information

A summary of the demographic information related to the representatives of the sample manufacturing SMEs is tabulated in Table I.

The respondents to the survey consisted of 85.4 percent males and 14.6 percent females and half of the respondents (53.8 percent) are in the age group of 41 to 50 years, followed by 30 years to 40 years (27.3 percent), above 50 years (15.8 percent) and less than 30 years (3.1 percent). Most of the respondents were manager (37.7 percent), followed by owner (21.9 percent), director (17.7 percent), head of department (15.4 percent) and owner and manager (7.3 percent). Main activities of responded SMEs are electrical and electronics (41.9 percent), followed by apparel and textiles (20.8 percent), food and beverage (14.2 percent), rubber and plastics (18.1 percent), and chemical products (5.0 percent). Almost half of the respondents have six to ten years attachment in the organization (49.6 percent), followed by more than 10 years (25.8 percent), two to five years (23.8 percent) and less than two years (0.8 percent). Majority of the respondents have more than ten year's attachment in the industry (80.4 percent), followed by six to ten years (16.2 percent) and two to five years (3.5 percent). Majority of the respondents were working in

Respondents background	Frequency	Percentage	Cumulative percentage
Gender of respondent			
Male	222	85.4	85.4
Female	38	14.6	100.0
Age of respondents			
Less than 30 years	8	3.1	3.1
30 to 40 years	71	27.3	30.4
41 to 50 years	140	53.8	84.2
Above 50 years	41	15.8	100.0
Designation			
Owner	57	21.9	21.9
Manager	98	37.7	59.6
Owner manager	19	7.3	66.9
Managing director	46	17.7	84.6
Head of department	40	15.4	100.0
Main activities of the SMEs			
Electrical and electronics	109	41.9	41.9
Apparel and textiles	54	20.8	62.7
Food and beverage products	37	14.2	76.9
Rubber and plastics	47	18.1	95.0
Chemical products	13	5.0	100.0
Year of attachment in organization			
< 2 years	2	0.8	0.8
2 – 5 years	62	23.8	24.6
6–10 years	129	49.6	74.2
> 10 years	67	25.8	100.0
Year of attachment in industry			
< 2 years	–	–	0.0
2 – 5 years	9	3.5	3.5
6 – 10 years	42	16.2	19.7
> 10 years	209	80.3	100.0
Company's number of employees			
5 – 75	65	25.0	25.0
76 – 200	195	75.0	100.0
Company's annual sales turnover			
Between $2m and $3m	40	15.4	15.4
Between $3.1m and $4m	47	18.1	33.5
Between $4.1m and $5m	173	66.5	100.0
Total		260	100

Table I. Respondents background

medium-sized SME with 75 to 200 employees (75 percent), while another 25 percent working in small-sized SME with 5 to 75 employees. Most of the company's annual sales turnover was between $4.1 and $5m (66.5 percent), followed by between $3.1 and $4m (18.1 percent) and between $2 and $3m (15.4 percent).

5.2 Descriptive information for the data

Table II displays the results of green initiatives, intention toward green, green technology adoption and firm's sustainable green practices. Generally, all the items recorded mean values above 3.00 and below 5.00. This result showed that all the items are relevant to the research and are moderately strongly related to the constructs of study. Most of the standard deviation

Factor	Items	Mean	SD
Energy management	EE1 – ensures activities minimize the amount of energy used	4.763	0.914
	EE2 – ensures activities minimize the emissions to air	3.324	1.065
	EE3 – set measurable targets for reducing energy usage	4.902	0.953
	EE4 – applies effective strategies in improving energy management	3.617	0.984
	EE5 – uses high-energy efficient lighting	4.758	1.054
	EE6 – regularly monitors trends in energy consumption	4.521	1.083
Water conservation	WC1 – promotes the re-use of water in production process	4.619	1.065
	WC2 – set measurable targets in reducing water usage	3.904	0.961
	WC3 – applies effective strategies in improving water conservation	3.171	1.031
	WC4 – installs water-efficient devices to control water usage	4.256	0.990
	WC5 – regularly monitors the trends in water usage	3.525	1.067
	WC6 – ensures its activities minimize the amount of effluent to water	4.916	1.012
Waste management	WM1 – ensures in minimizing the amount of waste from its activities	3.163	0.959
	WM2 – promotes the recycling of waste by using the most environmentally safe procedures available	3.515	1.084
	WM3 – set measurable targets for waste reduction	3.274	1.037
	WM4 – ensures the disposal of hazardous waste appropriately by complying with all existing legislation standards	4.651	0.987
	WM5 – monitors and records on-site and off-site waste disposal	3.124	1.053
	WM6 – has waste storage facilities that meet environmental requirements	4.462	0.964
Intention toward green	ITG1 – improve financial performance	4.651	0.931
	ITG2 – benefit from government's incentives	3.502	1.066
	ITG3 – gain market opportunities	3.372	1.290
	ITG4 – complying with Government's legislation	4.335	1.179
	ITG5 – adhere to Malaysia Green Technology Policy	4.241	0.955
	ITG6 – contributes to reducing negative impacts on the environment	3.147	0.937
Green technology adoption	GTA1 – energy efficiency	3.652	1.026
	GTA2 – carbon footprint	3.215	0.941
	GTA3 – green technology financing scheme	4.537	1.029
	GTA4 – green tag	3.872	0.984
	GTA5 – renewable energy	4.435	1.249
	GTA6 – green building	3.952	1.147
Sustainable green practices	SGP1 – requires all suppliers meet certain environmental criteria before sourcing materials	4.642	0.945
	SGP2 – products are designed in a way that minimizes adverse impact on the environment	4.214	1.091
	SGP3 – uses Life Cycle Analysis to assess the environmental impact of the product	4.815	1.065
	SGP4 – identifies activities that are environmentally harmful and provides alternatives that minimize these harmful effects	3.673	0.913
	SGP5 – carries out environmental audits at regular intervals	3.362	1.072
	SGP6 – has a clear vision of the importance of environmental policies	4.151	0.972

Table II.
Extent of sustainable green practices implementation

values were slightly over 1.00, if not close to 1.00, indicating a good dispersion from the mean. Furthermore, the descriptive statistics in Table II indicates that the data collected are not deviated from the normal distribution and good for further analyses.

5.3 Measurement model

CFA by means of SEM was used in this research to evaluate green initiatives on firm's sustainable green practices. SEM is used since it could relate a series of observable variables to be directly or indirectly related to the latent variables or factors (Hays *et al.*, 2005). Overall, the measurement model's fit indices showed adequate fit: $\chi^2 = 195$, df = 144; $\chi^2/\text{df} = 1.4$. The improved model showed the CFI and TLI values of 0.99 and 0.98, respectively, while the

RMSEA was 0.05. As shown in Table III, the factor loadings, Cronbach's α scores, Average Variance Extracted (AVE) and Composites Reliability (CR) indices of all factors are with high value. The Cronbach's α and CR values all above 0.70 show that the measurement of the constructs is all reliable (Hair *et al.*, 2010). According to Fornell and Larcker (1981), AVE higher than 0.50 assures that more than 50 percent of the variance of the factor is due to its indicators and is considered valid. Since all the items of the model have high factor loadings (above 0.70) and the AVE of the constructs are 0.76 and higher, these readings show that the constructs are content valid (Hair *et al.*, 2010).

Table IV shows the squared correlation coefficient of the constructs and the bolded numbers are the AVE of the respective construct. Since all the AVE values are above squared correlation coefficient of the related constructs, the discriminant validity of all constructs is proven (Hair *et al.*, 2010). With all these values, it has proven that the measurement of the model met the requirement of reliability, content validity, convergent validity and discriminant validity. Therefore, the testing of the structural model was followed suit.

Items	Factor loading	Cronbach's α	Average variance fxtracted	Composite reliability
EM2	0.89	0.949	0.87	0.95
EM3	0.95			
EM6	0.95			
WC1	0.76	0.901	0.76	0.80
WC2	0.96			
WC3	0.84			
WC6	0.89			
WM2	0.87	0.951	0.81	0.95
WM3	0.99			
WM5	0.95			
ITG1	0.95	0.917	0.85	0.92
ITG2	0.90			
ITG4	0.85			
ITG6	0.86			
GTA1	0.79	0.920	0.80	0.92
GTA5	0.94			
GTA6	0.95			
SGP1	0.92	0.907	0.82	0.87
SGP2	0.85			
SGP3	0.93			
SGP5	0.97			

Notes: EM, energy management; WC, water conservation; WM, waste management; ITG, intention toward green; GTA, green technology adoption; SGP, sustainable green practices

Table III.
Reliability and validity test of model

	EM	WC	WM	ITG	GTA	SGP
EM	*0.87*					
WC	0.39	*0.76*				
WM	0.07	0.26	*0.81*			
ITG	0.28	0.36	0.11	*0.85*		
GTA	0.37	0.31	0.17	0.35	*0.80*	
SGP	0.35	0.36	0.11	0.41	0.40	*0.87*

Notes: EM, energy management; WC, water conservation; WM, waste management; ITG, intention towards green; GTA, green technology adoption; SGP, sustainable green practices

Table IV.
Discriminant validity

5.4 Structural model estimation and fit

SEM strategies were employed in this second step to assess the association among six constructs applied in this study. First, Table V shows the hypotheses, parameter estimated and their respective p-value. The result shows that there is a positive and significant direct relationship between energy management, water conservation and waste management toward sustainable green practices ($\beta = 0.355$, $p < 0.001$; $\beta = 0.313$, $p < 0.010$; $\beta = 0.340$, $p < 0.001$, respectively). Therefore, *H1a*, *H1b* and *H1c* are accepted. These results show that for every unit increase of energy management, sustainable green practices will be increased by 0.355 units and for every unit increase of water conservation, sustainable green practices will be increased by 0.313 units and for every unit increase of waste management, sustainable green practices will be increased by 0.340 units.

Second, to assess the mediation effect among five constructs, Structural Nested Model was applied in this study. Baseline model represented the mediating model and hereafter known as Model 1. The paths were itemized from energy management, water conservation, and waste management to intention toward green, and from intention toward green to sustainable green practices. The fit of the model was adequate $\chi^2 = 217.4$, df = 146; $\chi^2/\text{df} = 1.47$. The CFI and TLI values were 0.99 and 0.98, respectively, and the RMSEA was 0.05. Therefore, the Model 1 deemed acceptable. Beside Model 1, the four nested models were tested. A direct path was added in Model 2, from energy management to sustainable green practices. Model 3 and 4 are similar to the baseline model, besides the inclusion of two waste management and energy management paths to the former, whereas water conservation and energy management for the latter to sustainable green practices. Finally, in Model 5, three direct paths were added, i.e. energy management, waste management, and water conservation to sustainable green practices. Therefore, Models 2, 3, 4 and 5 nested the baseline model.

Table VI illustrates the differences between χ^2 where the baseline model found to be insignificant compared to the other four models. Based on model parsimony's principle, these results propose that the data can best fit the baseline model, which support the exclusion of direct effects. Therefore, it can be concluded that intention toward green fully mediates the relationship between green initiatives (energy management, waste management and water conservation) as well as SMEs sustainable green practices. Thus, *H6* is accepted.

Table V.
Result of direct relationship

Hypotheses	Parameter estimate	*p*-value
H1a: SGP ← EM	0.355***	0.000
H2b: SGP ← WC	0.313	0.010
H3c: SGP ← WM	0.340***	0.000

Notes: SGP, sustainable green practices; EM, energy management; WC, water conservation; WM, water management. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table VI.
Results of structural nested model comparison

	χ^2	df	$\Delta\chi^2$	RMSEA	CFI	TLI
Model 1	217.4	146	1.49	0.05	0.99	0.989
Model 2	205.3	145	1.42	0.05	0.99	0.989
Model 3	201.6	143	1.41	0.05	0.99	0.989
Model 4	203.7	144	1.41	0.05	0.99	0.989
Model 5	198.9	142	1.40	0.05	0.99	0.990

5.5 Alternative structural model

An alternative model was executed to test the direct influences of intention toward green with energy management, water conservation, waste management and sustainable green practices. The alternate model's results were significant $\chi^2 = 199$, df = 143; $\chi^2/df = 1.4$. The CFI and TLI were 0.99 and 0.98, respectively, and RMSEA was 0.05, yielding additional support for the hypothesized relationships. Table VII presents the model parameters and *t*-values. The result describe the presence of a significant relationship between intention toward green and sustainable green practices; therefore, *H2* is accepted. In addition, the three green initiatives in this study (energy management, water conservation and waste management) positively related to intention toward green, and therefore, *H3*, *H4* and *H5* are accepted.

Finally, the moderation influence was examined by using the approach defined by Ping (1996) that draws on the two-step procedure of Anderson and Gerbings (1988). *H7* predicted that green technology adoption moderates the relationship between intention toward green and sustainable green practices. To avoid multicollinearity, the predictor (intention toward green) and the moderator (green technology adoption) have been mean-centered before computing the product terms (intention toward green × green technology adoption). Table VIII shows the result for the moderator hypotheses (*H7*). There was no moderation effect found for the relationship between intention toward green and sustainable green practices providing no support for *H7*.

6. Discussion and implication

First, this study examined the dimension of green initiatives within manufacturing SMEs. With regards to the direct effects, the green initiatives forces (energy management, water conservation and waste management) influence manufacturing SMEs to adopt sustainable green practices. Based on the findings, energy management found to be the strongest determining factor of managers' environmental concern followed by waste management and water conservation. This could be attributed to the fact that one's energy saving practices are largely influenced by the SMEs resources availability and it is found that a company's measures of energy management contribute return of investment through governments initiated programs. Relating to waste management initiatives, managers know that the disposition of scheduled wastes is given high priority as penalties for illegal dumping are quite strictly enforced. With regards to water conservation, the findings substantiate the findings of Young *et al.* (2000) in which SMEs believe that reducing the amount of water

Relationship	Estimate	*t*-value
Intention towards green and sustainable green practices	0.24	4.2 ($p = 0.000$)
Energy management and intention towards green	0.39	5.6 ($p = 0.000$)
Water conservation and intention towards green	0.27	4.9 ($p = 0.000$)
Waste management and intention towards green	0.31	5.2 ($p = 0.000$)

Table VII. Model parameter and *t*-values

	β	SE	T	p-value
Dependent variable – sustainable green practices				
Intention toward green	0.183***	0.053	3.485	0.000
Green technology adoption	0.202***	0.048	4.167	0.000
Intention towards green × green technology adoption	0.018	0.030	0.605	0.545

Notes: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Table VIII. Moderation analysis

used on-site will generally reduce effluent production and associated costs as well as lowering impact on the environment. The positive link shows that managers have positive green initiatives and think that tackling environmental issues needs to be their top priority. Furthermore, managers who possess ecological value, knowledge and skills have the added advantages that will automatically trigger them to embrace green initiatives. The findings are in line with prior research findings of Kannan and Boie (2003) and Thollander and Ottosson (2010), who found that green initiatives are significant in their studies and recognized the economic and environmental benefits that can deliver to SMEs.

Second, the study focused on examining how managers' intention toward green has the mediating role in the relationship between green initiatives and sustainable green practice. The result indicates that owners/managers intention toward green fully mediates the relationship between green initiatives (water conservation waste management and energy management) and SMEs sustainable green practices. This finding is in line with findings from past research works (Bansal and Roth, 2000; Banerjee *et al.*, 2003; Gonzalez-Benito and Gonzalez-Benito, 2006) according to which the implementation of sustainable green practices is controlled by a range of motivating internal factors including personal values, attitudes and intentions, as well as external factors derived from various stakeholders and institutional pressures.

Finally, the study examine whether green technology adoption moderates on the relationship between intention toward green and sustainable green practices in manufacturing SMEs. The moderation test revealed that green technology adoption is not an influencer on manufacturing SMEs sustainable green practices. This could be due to three reasons; first, the SMEs owners/managers' lack of green knowledge and adopt conservative strategy as the costs of understanding and responding to government's mitigation policies are not immediate offsets. Second, the changes in patterns of demand for goods and services as a result of increasing awareness, ethical purchasing and pro-environmental behavior among customers impact businesses and their competitiveness, through which the SMEs managers may seek comparative advantage in green businesses, where no such advantage naturally lies. Third, going green is seen as adopting technological innovations to achieve corporate social responsibility, and this is a costly affair. In this regard, managers are less motivated to invest and develop internal capabilities to improve their sustainability when they do not see any further market opportunities and benefits of adopting advanced alternative environmental practices that exceed the requirements of their stakeholders.

In summary, this study extends from the work of Gadenne *et al.* (2009) which revealed that the interaction between resource commitments with green initiatives in predicting sustainable green practices had a mix of significant and non-significant interaction terms. However, this imply that managers have a positive perception on the interaction between nature and humans (Dunlap *et al.*, 2000) because they have the confidence on the effectiveness of sustainable green practices and personal environmentally conscious behaviors in protecting the environment. SMEs managers who demonstrate pro-environmental attitudes have not only adopted more green initiatives (Dunlap *et al.*, 2000), but also displayed more organizational involvement in such practices. In other words, managers pro-environment worldview, which serves as their cognitive value function, is able to influence organizational environmental strategy and outcomes.

Practical implications are manifested in this study and it demonstrates that owners/managers only invest little attention on green technology adoption. Manufacturing SMEs are encouraged to integrate Green Technology policy into their firm's policy as this aspect is highly beneficial to firms that consider the prospects of sustainability. On top of that, manufacturing SMEs are advised to increase their awareness of green technology, as awareness encourages owners/managers to develop a complementary set of sustainable green

practices. These practices are deemed as indispensable, unique, irreplaceable and difficult to be imitated by competitors. These practices will help a firm to increase its market competitiveness and develop sustainable competitive advantage. In this light, being in sustainable green practices is significant for manufacturing SMEs, particularly those aiming to enhance their appeal as a supply chain partner for western firms as well as those with the vision to build a respectable international reputation. However, the collective sustainable green practices performance is susceptible to the contributions of employees, managers, internal departments as well as contributions from external supply chain partners in various environmental areas.

In view of managerial implications, the results are of interest to owners/managers who are facing the decisions regarding the implementation of sustainable green practices. While some SMEs view sustainable green practices as a cost of doing business, findings from the study of McKeiver and Gadenne (2005) and Cordano *et al.* (2010) provide evidence of benefits such as cost reduction and quality improvement in the long run. The results also help owners/managers understand the meaning of a well-developed green initiatives and what other firms are doing in regards to sustainable green practices. This study is a step forward in the right direction toward a resolution of the conflict between competing paradigms that drive the strategy of intention toward green and sustainable green practices. While the competing paradigms discuss either resource productivity (Porter and Van der Linde, 1995) or cost that exceeds benefits (Litman, 2015), results of this study indicate that sustainable green practices can positively affect operational performance and produce benefits that exceed those costs.

On the other hand, there are relevant implications for practitioners and governments based on our findings. The importance of green initiatives has been demonstrated in this study while improving sustainability of manufacturing SMEs form a managerial point of view. Besides, it is crucial for manufacturing SMEs to incorporate environmental management monitoring, education, and training systems into their organizations. This is due to the fact that the business decision of environmental management required years of continuous organizational commitment and is not made at a single point in time. It is suggested that manufacturing SMEs appoint an environmental manager classified under green job category for green initiatives implementation and incorporate "four pillars" of Green Technology Policy into organization's corporate strategic agendas. From a government perspective, the level of perceived uncertainty should be reduced by government assistance to SMEs based on the results in order to ensure the successfulness of green initiatives. There are various programs that may reduce the perceived uncertainty. For instance, training programs such as green technology adoption for SMEs owners/managers. The understanding of green technology changes may be achieved and a clearer view of potential evolution on sustainability of development that will conserve the natural environment and resources can be provided.

7. Conclusion

Globalization has encouraged the emergence of customers who are environmentally conscious and supportive of sustainable green practices. The results of this study indicate the emergence of a valid and reliable sustainable green practices construct, and the impact of this construct on business performance. The sustainable green practices can be considered as a new, but overlooked capability of operations management. It is considered overlooked because typically little is known about these systems, despite several international standards and environmental systems concerning environmental, health and safety which have been around for some time. The focus of this study is to define and bring about a better understanding of the impacts of green initiatives, owners/managers intention toward green as well as the green technology adoption in manufacturing SMEs.

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