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A gateway to realising sustainability performance via green supply chain management practices: A PLS–ANN approach

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ABSTRACT

This study aims to critically evaluate whether the implementation of selected green supply chain management (GSCM) practices will drive and empower sustainability among ISO14001-certified manufacturing firms in Malaysia. Besides this, the significance and strength of the relationships between GSCM practices and sustainability performance were also investigated and subsequently ranked using a two-stage PLS–ANN approach. Primary data was collected from 178 large ISO14001-certified Malaysian manufacturers through self-administered survey questionnaires. PLS–SEM using SmartPLS 3.0 and artificial neural network analysis (ANN) served as statistical analysis tools. This study draws out the prominence of GSCM practices as strategies to achieve sustainability performance. However, the relationship between supplier selection and supplier evaluation with sustainability performance is surprisingly insignificant. Furthermore, cooperation with customers is found to be significantly but negatively related to sustainability performance. Nevertheless, this contributes new knowledge to the literature with sensible justifications being offered accordingly.

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1. Introduction

In today's competitive world, it is common knowledge that sustainability issues have become increasingly challenging as a result of fast-paced globalization, industrialization (Fornasiero et al., 2016) and various environmental and socio-economic problems caused by illegal, unethical or irresponsible business operations in the process of sourcing and acquiring for materials, manufacturing and logistics, disposal of products at the end of their useful life, and waste management. According to a research conducted by Hohensee (2013), it is estimated that 3,000 of the world's largest corporations contributed over $2 trillion of negative social and environmental externalities a year. Manufacturing firms are of no exception (Sutherland et al., 2016).

In the course of fifty over years, Malaysia has been undergoing rapid urbanization and industrial developments which caused unprecedented changes and raised sustainability issues not only in the natural environment but also on the socio-economic landscape in the country (Hezri & Nordin Hasan, 2006). According to Afroz, Hassan, and Ibrahim (2003), Aini, Fakhru'l-Razi, and Suan (2001) and Said (2003), untreated and hazardous industrial toxic such as heavy metals, improper waste management and air pollution from industrial manufacturing all caused considerable environmental, socio-economic and health challenges among Malaysian residents, including episodes of water crises in the Klang Valley (Elfithri & Mokhtar, 2018). Besides this, according to Ramakreshnan et al. (2018), Malaysia has also experienced Urban Heat Island phenomenon and its associated implications as a result of rapid urbanization and industrial developments. Furthermore, according to Ichihara and Harding (1995), residents of Bukit Merah and Papan (near Ipoh, Perak, Malaysia) still feel the aftermath of the improper disposals of radioactive wastes as a result of the operations of a Japanese-Malaysian rare earth manufacturer, Asian Rare Earth Sdn Bhd. The affected residents suffered from cancers, birth and genetic abnormalities and disorders, and lead poisoning on top of psychological distress (Ichihara and Harding, 1995).

Researchers such as Beamon (1999) and Lin and Ho (2011) viewed manufacturing firms as the culprits responsible for most of the environmental problems leading to various safety and health risks to the employees and community. Past studies done by Sarkis (2006) and Zhang et al. (2008) claimed that manufacturing operations are increasingly projected in the public's limelight because of mounting pressures exerted by a plethora of internal and external stakeholders who are increasingly concerned about the natural environment as well as socio-economic welfare of all parties (Cherrafi, Elfezazi, Chiarini, Mokhlis, & Benhida, 2016).

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These immense pressures and pressing challenges cause firms to seriously contemplate the potential negative impacts their business activities have on the environment and on the social welfare of stakeholders (Mirhedayatian, Azadi, & Saen, 2014).

Various internal and external stakeholders are calling for more green products and practices (Ülkü & Hsuan, 2017). In order to address the pressing concerns and also to help to mitigate the environmental and socio-economic issues, manufacturing firms have taken the initiatives to integrate and implement green practices along their supply chains. Green supply chain management practices (GSCM) act as a resounding response to provide reasonable assurance to increasingly environmental conscious stakeholders (Adebanjo, Teh, & Ahmed, 2016; Scur & Barbosa, 2017). If green practices are being actively incorporated in a firm's supply chain and provided that this sound practice is properly ingrained in a firm's organizational culture, a firm will be increasingly able to project and enjoy a positive image in terms of environmentally friendly products, processes, systems and technologies (Vachon & Klassen, 2006; Vanalle, Ganga, Godinho Filho, & Lucato, 2017).

As such, this study aligns with the organizational goals of achieving long-term economic viability (maximizing shareholder's wealth) while championing good social and environmental performances by focusing on GSCM practices as corporate strategies (Neubert & Dyck, 2016). The triple bottom line which considers and balances all the three facets of economic, environmental and social performances corresponds with the idea of organizational sustainability, which is the focus of this study (Carter & Rogers, 2008; Schulz & Flanigan, 2016).

This study also aims to critically evaluate whether the implementation of GSCM practices will lead to the achievement and improvement of sustainability performance among ISO14001-certified manufacturing firms in Malaysia. This research is well-warranted, particularly on the Malaysian manufacturing landscape because the effects of GSCM practices on sustainability performance seems relatively under-researched in Malaysia (Lee, Ooi, Chong, & Lin, 2015).

The three main research questions are articulated as follows:

RQ1: What green factors in the form of GSCM practices determine sustainability performance?

RQ2: Is there any significant and positive relationship between each of the GSCM practice and sustainability performance?

RQ3: Among the significant predictor(s), which GSCM practice(s) has a greater association with sustainability performance?

This paper begins with an introduction, which is followed by a literature review section where the concepts of GSCM practices, sustainability performance and the past studies which attempt to connect these constructs are presented in a logical manner. Next, seven hypotheses are formed based on the conceptual model that is developed in the researchers' attempt to empirically establish the relationships between GSCM practices and sustainability performance. Next, the statistical techniques used to measure the relationships between these constructs are detailed out in the methodology section followed by discussions and justifications. Finally, a conclusion is drawn to explicate the relationships between GSCM practices and sustainability performance.

2. Literature review

2.1. Resource based view theory

The Resource Based View Theory which was developed by Barney in 1991 posits that firms that possess assets and resources which are then developed into capabilities and subsequently turned into competencies help to secure a firm's strategic competitive position by consistently outperforming its competitors (Barney, 1991). Since firms possess heterogeneous resources and capabilities and hence have unique competencies, they must devise sound strategies in order to win in this game of survival. In view of the increasing emphasis on sustainability (Rajeev, Pati, Padhi, & Govindan, 2017), this study proposed a set of green supply chain management practices as predictors of sustainability performance.

2.2. Green supply chain management (GSCM) practices

According to Dües, Tan, and Lim (2013), companies can no longer ignore green practices as "green" is the new lean where industries gradually shifted the paradigm towards green and sustainability. Following Hilmola (2018), green and sustainability have been identified as leading fields even in case study research works of supply chain management.

It is undeniable that the very well-recognized GSCM practices play a pivotal role in mitigating negative environmental and socio-economic footprints caused by business operations, including manufacturing firms (Bhanot, Rao, & Deshmukh, 2017). GSCM basically involves integrating green initiatives along a supply chain including, but not limiting to having proper waste management (Sarkis, 2003; Scur & Barbosa, 2017); transforming from the traditional 3R concept - reducing, reusing and recycling of materials and packaging to a more holistic 6R concept - reducing, reusing, recovering, redesigning, remanufacturing, and recycling of materials and packaging (Jayal, Badurdeen, Dillon, & Jawahir, 2010).

The seven GSCM practices which are the focus of this study include internal environmental management (IEM), cooperation with customers (CC), eco-design (ED), investment recovery (IR), supplier selection (SS), environmental collaboration (EC) and supplier evaluation (SE) which are developed by world-renowned researchers in the field of GSCM, including Paulraj (2011); Wu and Barnes (2016); Zhu, Sarkis, and Lai (2008) and many others. There are quite a number of other GSCM practices developed by various researchers besides the above-mentioned practices. For instance, Green Purchasing (Min & Galle, 2001; Rao, 2002), Green Information Systems (Esty & Winston, 2009), Reverse Logistics (Zhu, Sarkis, & Lai, 2007), Land Management Practices (Pullman, Maloni, & Carter, 2009), and Facility Conservation Practices (Pullman et al., 2009); just to name a few, are also categorized as GSCM practices.

Internal environmental management essentially means having highly-committed management teams in promoting green practices throughout the entire value chain by "walking the talk", such as designing and developing company policies and standard operating procedures (SOP) that aim at practising green initiatives and robustly enforcing the executions and implementations (Jabbour & de Sousa Jabbour, 2016; Scur & Barbosa, 2017). For example, according to PepsiCo (2011), Walkers Crisps of the United Kingdom has a policy in place to rigorously reuse and recycle so that at the end of the day no waste is sent to the landfill. Investment recovery, on the other hand, involves practising sale and recovery of scrap and machineries that are beyond repair (Rao & Holt, 2005). One practical example will be Sony Corporation of Japan recycling sludge to make cement, according to Gordon (2001).

Eco-design emphasises on green themes while designing and developing prototypes of products such as restricting or banning the use of hazardous or banned chemicals or materials at the initial stage of design as proactive environmental management measure (Pigosso, Rozenfeld, & McAloone, 2013). For example, according to Gordon (2001), Kyocera (one of the printer manufacturers in Japan) designs printers that have fewer components to replace and relatively cost less to use. Cooperation with customers, on the other hand, involves actively collaborating with customers to strive for cleaner and more energy-efficient production and also greener packaging (Zhu et al., 2008). According to Chien and Shih (2007) and Lamming and Hamapson (1996), approximately 75% of USA consumers claim that their purchase intentions are being influenced by brand reputation whereas an estimated 80% of USA consumers do not mind paying more for green products.

Supplier selection involves identifying potential suppliers and determining and selecting the right suppliers by using environmental capabilities and performance as selection criteria. Selecting the right suppliers is vital as it determines a firm's ability in championing the environmental and socio-economic stance of a firm (Min & Galle, 2001; Paulraj, 2011; Tseng & Chiu, 2013). For example, a study conducted by Cusumano and Takeishi (1991) found that component design capability was one of the main criteria in determining which suppliers to engage among the USA and Japanese auto assemblers.

Environmental collaboration on the other hand involves cooperating and collaborating with suppliers to develop environmental strategies as well as providing suppliers with services, materials, equipment, and specifications to better assist firms to strengthen the environmental prowess of the supply chain partners (Large & Thomsen, 2011; Paulraj, 2011). Besides this, environmental collaboration also serves as a vital sign to demonstrate firms' dedication and commitment to willingly devote multiple resources to better achieve their environmental objectives. Azevedo, Carvalho, and Machado (2011) and Gunasekaran, Lai, and Cheng (2008) argued that collaborating with suppliers for environmental purposes not only improves a firm's ability to coordinate and streamline operations and workflow in order to better respond to any changes in customer's requirements but also enhances customer satisfaction besides contributing to the minimization of business wastes, environmental and supply chain costs.

Supplier evaluation completes the loop by ascertaining that the initiatives are in accordance to the ambitions and goals of the firm by regularly monitoring suppliers' operations and environmental performance which also entails the benchmarking of various supply chain processes against evolving practices, laws and regulations (Large & Thomsen, 2011; Min & Galle, 2001; Paulraj, 2011; Vachon & Klassen, 2006).

All in all, GSCM practices are deemed to be the centripetal forces that impact sustainability performance in this study. This is because the researchers wish to zoom into a primary function (mainly operations) and a supporting function (procurement) of a value chain (Porter, 2008) to empirically evaluate the individual and collective impact of GSCM practices on sustainability performance.

2.3. Sustainability performance (SP)

One of the most well-adopted definitions of sustainability was published by the Brundtland Commission, where the term sustainability was coined as "development that meets the needs of the present without compromising the ability of future generations to meet their needs" (Brundtland, 1987, p. 8). In 2015, the United Nations Climate Change Conference declared that efforts must be taken to save Earth, and preventive measures certainly should not be limited to manufacturing aspect alone, but rather should include social, economic and organizational aspects as well (United Nations Framework Convention on Climate Change, 2015). At a broader level, organizational sustainability is comprised of three components; namely the economic performance, environmental performance, and social performance (Ahi & Searcy, 2013; Carter & Rogers, 2008; Seth, Shrivastava, & Shrivastava, 2016).

Sustainability performance comprehensively looks into issues such as investigating the potential negative impacts economic activities have on the environment in both emerging and advanced economies (Koo, Chung, & Ryoo, 2014); ascertaining that social well-being such as basic human needs as per Maslow's Hierarchy of Needs are met and satisfied (Seth et al., 2016); and assuring that environmental renewable and non-renewable resources are conserved so as to provide for and sustain future generations (Koo et al., 2014).

Past studies advocate that organizational sustainability lies at the intersection of economic, environmental, and social performances (Carter & Rogers, 2008; Seth et al., 2016). This point of view is in accordance to the concept of triple bottom line as advocated by Elkington (1998). Hence, sustainability performance is measured along these three dimensions in this study. The definitions of the constructs of sustainability performance are as follows:

(1) Economic performance: Economic performance taps into measuring a firm's ability to cut down on costs at various points of consumption including the procurement of resources, energy consumption, proper waste management, and fines incurred because of environmental accidents on top of measuring the respondent's perceived growth in sales, business volume, market share and the firm's ability to earn required profits (Chowdhury, 2014; Green, Zelbst, Meacham, & Bhadauria, 2012; Zhu et al., 2008).
(2) Environmental performance: Environmental performance measures the ability of firms to reduce water, air and soil pollutions; the capabilities of firms to execute proper waste management and to avoid or reduce the use of hazardous and/or toxic materials plus any improvements in terms of reduction in frequency of environmental accidents and achievements in energy savings (Chowdhury, 2014; Rao, 2002; Zhu et al., 2008; Zhu, Sarkis, & Lai, 2012).
(3) Social performance: Social performance involves measuring the impact of business behaviour on society (Clarkson, 1995; Tsoi, 2010). Social performance generally measures the well-being of employees in terms of whether employees are at least enjoying minimum wages and work benefits such as medical benefits, annual leave, clean drinking water, safe workplace et cetera as per Labour Law and whether employees are being subjected to ill-treatments, harassments or abuses at work (Bansal, 2005; Chowdhury, 2014; Tsoi, 2010).

3. Hypotheses development for the relationships between GSCM and sustainability performance

3.1. The relationship between internal environmental management and sustainability performance

Past literatures have reached a consensus that GSCM practices lead to performance improvements (Singh & Trivedi, 2016; Wu et al., 2014). It is an undeniable fact that top and middle level managers' support is crucial to bring company's innovations, technologies, practices and programmes to greater heights on the success barometer (Green et al., 2012). According to Wiengarten, Pagell, and Fynes (2013), ISO 14001 and associated internal environmental management systems are implemented across the entire supply chain to improve the environmental performance. Through examinations, Alvarez Gil, Jimenez, and Lorente (2001) and Bowen et al. (2001) have indicated that proactive GSCM approaches in the forms of continuous environmental improvement and development of capabilities to better mitigate environmental risks all lead to superior long-term economic performance. Besides this, De Giovanni (2012) further advocated that internal environmental management practices are effective drivers in improving all the bottom lines (including economic, environmental and social performances) directly and concurrently. Hence the formulation of our first hypothesis:

H1: Internal environmental management is positively and significantly related to sustainability performance.

3.2. The relationship between cooperation with customers and sustainability performance

Nowadays, organizations are getting more and more focused on fulfilling the needs and requirements of customers who are increasingly environmental conscious and are consequently demanding more "green" products and services in order to promote sustainability (Lee, Ooi, Chong, & Seow, 2014). Thus, by cooperating and collaborating closely with customers for eco-design, cleaner production, and greener packaging, organizations are asserted to be in a better position in the scale of sustainability (Diabat, Khodaverdi, & Olfat, 2013; Green et al., 2012). Besides this, Frosch (1994) posited that by having close proximity with upstream and downstream supply chain partners such as suppliers and customers will facilitate improvement in environmental performance. Furthermore, according to Van Hoek (2001), GSCM is a vital organisational philosophy to attain, improve and even sustain economic, environmental and social performances of a firm and its supply chain partners. Thus, the second hypothesis is developed:

H2: Cooperation with customers is positively and significantly related to sustainability performance.

3.3. The relationship between investment recovery and sustainability performance

Investment Recovery involves recovering, redeploying, and reselling existing surplus products, materials (including scrap) and capital equipment which are idle and redundant to get higher values (Zhu et al., 2008) and also to reduce storage requirements (such as reducing the costs and space of landfills), and have better fixed assets utilization (Atkinson, 2002) so as to minimize costs and wastes. According to Cottrill (1997), investment recovery is a practice that brings in many benefits because a majority of the proceeds generated by investment recovery form part of the profits for quite a number of industries, including the IT industry which generates enormous streams of computer and other hardware wastes, and so on. Thus, through industry best practices under the big umbrella of investment recovery, a firm has very good prospects in achieving and improving sustainability performance (Green et al., 2012; Lee et al., 2014). Our third hypothesis is therefore developed:

H3: Investment recovery is positively and significantly related to sustainability performance.

3.4. The relationship between eco-design and sustainability performance

Eco-design aims to help an organization to improve its sustainability performance by not only addressing the functionalities of products but also focusing on the technical enhancements and process designs that ultimately aim at alleviating associated potential negative environmental, economic, and social impacts throughout the product life-cycle (Lee et al., 2014; Singh & Trivedi, 2016; Zhu et al., 2008). Thus, a product with environmentally friendly design that strives to reduce and avoid the use of hazardous substances (such as complying to European Union's Directive - Restriction of Hazardous Substances (RoHS) in electrical and electronic equipment) is linked to the achievement and improvement of sustainability performance (Green et al., 2012). Fourth hypothesis is then formulated as such:

H4: Eco-design is positively and significantly related to sustainability performance.

3.5. The relationship between supplier selection and sustainability performance

Appropriate and proper selection of suppliers is especially vital to a firm's capability in championing its sustainability aspirations and ambitions (Kannan, de Sousa Jabbour, & Jabbour, 2014). Traditionally, firms select suppliers by considering a variety of criteria such as price, quality, value-for-money bargains, after-sales services and support, on-time delivery, flexibility and so on (Govindan, Khodaverdi, & Jafarian, 2013). Supplier selection marks the first step in the procurement mechanism to ensure enduring success of a supply chain and also in response to pressing sustainability concerns by various stakeholders (Govindan et al., 2013; Seuring & Müller, 2008). Hence, our next hypothesis is developed:

H5: Supplier selection is positively and significantly related to sustainability performance.

3.6. The relationship between environmental collaboration and sustainability performance

Besides this, environmental collaboration which involves managing appropriately-chosen suppliers with a positive mindset is an essential approach that aids firms to develop exceptionally great skills on the part of supply chain partners in order to better achieve environmental competence (Caniëls, Gehrsitz, & Semeijn, 2013; Diabat, Khodaverdi, & Olfat, 2013; Yu, Chavez, & Feng, 2017). Additionally, environmental collaboration also exemplifies a firm's willingness and commitments to devote multiple resources to better achieve its environmental objectives. Hence, we hypothesized that:

H6: Environmental collaboration is positively and significantly related to sustainability performance.

3.7. The relationship between supplier evaluation and sustainability performance

Supplier evaluation which involves reviewing, assessing, benchmarking, and auditing various supply practices against evolving regulations, legislations, and directives imposed by relevant regulatory bodies and authorities as well as voluntary codes of practice such as the International Organization for Standardization (ISO) completes the cycle by ascertaining that the initiatives in place are in accordance with the goals and aspirations of a firm in its efforts to continuously strive for sustainability excellence (Hsu & Hu, 2009; Large & Thomsen, 2011; Vachon & Klassen, 2006; Zhang, Pawar, & Bhardwaj, 2017). Our final hypothesis is thus formulated:

H7: Supplier evaluation is positively and significantly related to sustainability performance.

In view of the above rationales, the relationships between GSCM practices and sustainability performance are hypothesized as above. Based on the hypotheses formulated above, a conceptual model linking GSCM practices and sustainability performance is formed (as shown in Fig. 1).

4. Methodology

This study adopts self-administered questionnaires (with 7-point Likert scale) to gauge and measure the impact of the implementation of GSCM practices on sustainability performance among ISO14001-certified manufacturing firms in Malaysia.

The target respondents are employees who are executive level and above who possess sound knowledge on the implementation of green initiatives in their firms and are well aware of the associated impacts of the green strategies on the sustainability performance of the firms (Dangelico & Pujari, 2010). Various respondents from different departments participated in this survey; with

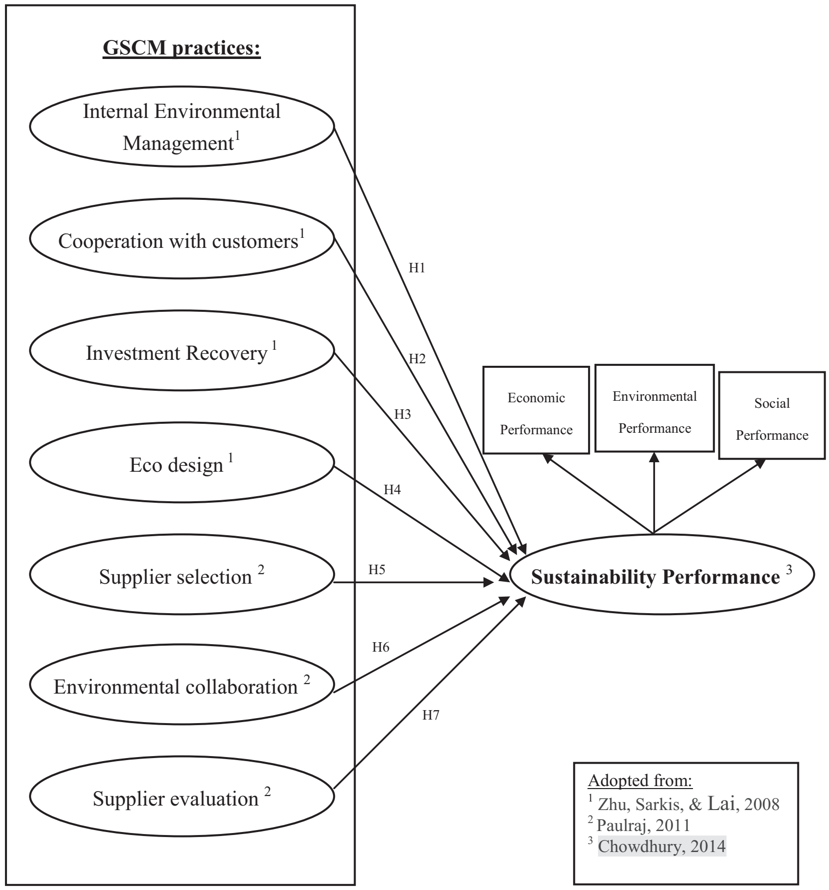

Fig. 1. Proposed research framework.

a respondent representing each firm. The respondents are mostly environment, health and safety (EHS) executives, quality assurance (QA) engineers, supply chain management (SCM) executives and so on.

The sampling frame consists of all large ISO14001-certified manufacturing firms in Malaysia as per the Federation of Malaysian Manufacturers (FMM) Directory 2015. ISO14001-certified manufacturing firms are selected because these firms are expected to actively and rigorously engage in the adoption and implementation of green initiatives (Darnall, Jolley, & Handfield, 2008). Large firms with at least 200 full-time employees are targeted in view of the firms' capabilities and availability of more resources to implement GSCM strategies compared to smaller firms (Zhu & Sarkis, 2004).

The FMM Directory 2015 contains over 2000 manufacturing firms of varied industries and sizes (regardless of whether the company is local or joint venture/ subsidiary of a multinational corporation), and details such as the number of employees (reflecting firm size), annual sales, current and future export markets, brand names and so on are also detailed out. Furthermore, FMM is also considered as one of the largest economic organisations in Malaysia (FMM Directory, 2015). Hence, FMM Directory 2015 is well-perceived as a valid representation for the population of this study.

A pilot study was first conducted by the authors by personally collecting data from 40 GSCM industry practitioners using self-administered survey questionnaires before rolling-out the survey instrument full-scale (with minor amendments made as detailed out in Section 4.1). Pilot study was completed within one month from the commencement of data collection in August 2016. This was immediately followed by the actual study that was conducted from September to December 2016 by a team of paid research assistants who personally visited the target respondents during the 4-month data collection period. The research assistants first made appointments with the target respondents via emails and/or phone calls prior to visiting the firms. Out of the remaining 274 large ISO14001-certified manufacturing firms, a total of 178 firms participated in the actual study. Since there are no missing values or incomplete responses, this brings us a response rate of 64.96%, with 178 usable data.

The demographic profile of the sampled firms which participated in the survey is presented in Table 1. A majority of the participating firms are long-established, with 96.6% of the firms boasting more than 10 years of track record. Almost one-third of the participating firms are in the category of "electrical and electronics (E&E)". 24.2% of the firms categorized as "Other" are mostly engaged in producing solder products, cement products, solar panels, pharmaceutical products, medical devices, quarry products, jewellery, remanufacturing of recyclable products and et cetera. 100% of the participating firms are large with at least 200 employees. The definitive guide of firm size follows the definitions set-out by Hasan and Jandoc (2010). A majority of the participating firms are multi-national corporations (MNC), amounting to a whopping 73% whereas the balance 27% consist of state-owned and private family-owned companies. Out of the 178 firms that participated in this survey, 177 firms are ISO14001-certified whereas there is only 1 firm which has ceased to be ISO14001-certified as in December 2016. 41% of the respondents are executives who occupy positions such as Officer, Engineer, Senior/Staff Engineer, System Analyst, As-

Table 1
Demographic profile of sampled firms.

	Total	Percentage
Age of firms		
≤ 10 years old	6	3.4
> 10 years old	172	96.6
Primary activity of firms		
Electrical & electronics products	54	30.3
Textiles & textile products	2	1.1
Computer, IT & technological products	11	6.2
Beverage & tobacco products	1	0.6
Paper products	6	3.4
Primary & fabricated metal products	15	8.4
Furniture and related product	1	0.6
Other	43	24.2
Food products	5	2.8
Rubber & plastic products	20	11.2
Wood & sawmill	2	1.1
Apparel manufacturing	1	0.6
Transportation equipment	6	3.4
Chemical products	11	6.2
Ownership		
Foreign owned company	130	73.0
State owned company	8	4.5
Local private family owned company (Chinese)	31	17.4
Local private family owned company (Non-Chinese)	9	5.1
Status of firm (ISO14001-certified)		
Yes	177	99.4
No	1	0.6
Job position		
Executive	73	41.0
Manager/ Senior Manager	88	49.4
General Manager/ Director/ CEO	14	7.9
Other	3	1.7

sistant Manager and et cetera whereas 57.3% of the respondents occupy Managerial positions and above. The remaining 1.7% occupy positions such as Assistant Officer, ISO14001 Management Representative and so on.

4.1. Variables and measurement

All 31 items of measurement for GSCM practices are adopted from Zhu et al. (2008) and Paulraj (2011) whereas all 20 items of measurement for sustainability performance are adopted from Chowdhury (2014), with only 1 item (EVP7) being changed from a negative statement to a positive statement which goes like this: “We do not fulfil the criteria regarding environmental legislation of the country” to “We fulfil the criteria regarding environmental legislation of the country” to maintain consistency.

All items of IEM, CC, IR and ED are being measured using 7-point Likert scale with 1 = Definitely Not Considering It, 2 = Somehow Not Considering It, 3 = Planning To Consider It, 4 = Considering It Currently, 5 = Initiating Implementation, 6 = Somehow Implementing Successfully and 7 = Definitely Implementing Successfully.

On the other hand, all items of SS, EC and SE and Sustainability Performance are being measured using 7-point Likert scale with 1 = Strongly Disagree, 2 = Disagree, 3 = Slightly Disagree, 4 = Neutral, 5 = Slightly Agree, 6 = Agree and 7 = Strongly Agree.

5. Results

The relationships among the constructs as shown in Fig. 1 are examined using Partial Least Square (PLS-SEM) software SmartPLS 3.0. The rationale behind the selection of PLS-SEM over covariance-based SEM is not only because the sample size satisfies the 1:10 ratio for PLS path analysis (Hair et al., 2016) but also because this is an exploratory study instead of confirmatory study, and hence deeming PLS-SEM a more appropriate tool compared to CB-SEM (Hair, Ringle, & Sarstedt, 2011). Furthermore, according to Hair (2017), PLS-SEM is preferred over covariance-based SEM software such as AMOS because PLS-SEM is specifically designed for prediction purposes. Besides this, Henseler and Sarstedt (2013) argued that PLS-SEM is not so sensitive to sample size compared to CB-SEM and stringent dataset requirements such as multivariate normality is not strictly mandatory. Out of 51 items of measurement, 3 items are dropped from path analysis because their factor loading is lower than 0.7 (Yu, 2012) and this has subsequently reduced the total number of items to 48.

5.1. Measurement model evaluation

5.1.1. Reliability

The reliability of the measurement model has been established by examining the Composite Reliability and Cronbach’s alpha. Since all the values of Composite Reliability and Cronbach’s Alpha exceed or nearly touching the recommended thresholds of 0.6 (Bagozzi & Yi, 1988) and 0.7 (Nunnally & Bernstein, 1994) respectively, hence, the measurement model is confirmed to be highly reliable.

5.1.2. Convergent validity

Convergent validity denotes the degree to which items of a construct should converge (Hair et al., 2011). According to Anderson and Gerbing (1988) and Chen et al. (2014), convergent validity can be established provided that all items load significantly on their denominated latent variables. In this study, convergent validity was assessed by examining factor loadings, composite reliability and average variance extracted (AVE). Tables 2 and 3 clearly demonstrated that convergent validity has been established since factor loadings, composite reliability and AVE have exceeded the recommended thresholds of 0.7 (Chen et al., 2014), 0.6 (Bagozzi & Yi, 1988) and 0.5 (Fornell & Larcker, 1981) respectively.

5.1.3. Discriminant validity

According to Churchill (1979) and Hair, Ringle, and Sarstedt (2013), discriminant validity denotes the degree to which the latent variables are uniquely distinct from one another. According to Fornell and Larcker (1981), Gefen, Straub, and Boudreau (2000) and Kling (2001), discriminant validity is established when the square root of average variance extracted (AVE) for each construct is greater than the correlations of all other constructs. Table 4 clearly demonstrates that discriminant validity has been achieved since all of the on-diagonal values ($\sqrt{AVE}$) are greater than the off-diagonal values (correlations of all other constructs).

5.1.4. Common method bias (CMB)

Furthermore, common method bias (CMB) did not pose a problem in this study even though the data on GSCM practices and Sustainability Performance was collected from the same source. This is because besides adopting procedural and statistical remedies such as ensuring the anonymity of respondents as advocated by Podsakoff, MacKenzie, Lee, and Podsakoff (2003), Harman’s Single Factor Test was also performed and the results confirmed that common method bias indeed did not pose a problem because the cumulative percentage of the “total variance explained” is only 26.124% (less than 50% threshold).

5.1.5. Non-response bias

Following Hew and Kadir (2017), non-response bias was evaluated by using independent t-test or chi-square test on all key variables amongst the early and late respondents. The results indicated no significant differences for IEM ($t = -0.483$, $p = 0.631$), IR ($t = 0.779$, $p = 0.438$), CC ($t = -1.236$, $p = 0.220$), SS ($t = -0.821$, $p = 0.414$), and EC ($t = -1.714$, $p = 0.090$). Even though

Table 2
Reliability and convergent validity tests.

	Cronbach's alpha	Composite reliability	AVE
Internal environmental management	0.8912	0.9126	0.5993
Cooperation with customers	0.9291	0.9489	0.8228
Investment recovery	0.6560	0.8481	0.7372
Eco design	0.9204	0.9488	0.8608
Supplier selection	0.9634	0.9714	0.8716
Environmental collaboration	0.9401	0.9526	0.7705
Supplier evaluation	0.9487	0.9670	0.9071
Economic performance	0.9424	0.9584	0.8523
Environmental performance	0.8986	0.9203	0.6231
Social performance	0.9432	0.9541	0.7489

Table 3
Cross-loading results.

	CC	EC	ED	EP	EVP	IEM	IR	SE	SP	SS
CC1	**0.9317**	0.4512	0.4628	0.0838	0.1403	0.2597	0.2342	0.3758	0.0274	0.4432
CC2	**0.919**	0.4001	0.4141	0.094	0.1121	0.2613	0.21	0.4345	0.0138	0.4143
CC3	**0.9035**	0.4106	0.3994	0.0092	0.184	0.1954	0.1482	0.4344	0.0382	0.3953
CC4	**0.8731**	0.537	0.3648	0.0491	0.1341	0.1772	0.2143	0.4884	−0.0187	0.4419
EC1	0.3811	**0.8406**	0.2206	0.1523	0.29	0.2706	0.2052	0.4452	0.1764	0.4883
EC2	0.3914	**0.8346**	0.2514	0.0522	0.3075	0.2457	0.2141	0.3565	0.139	0.4338
EC3	0.402	**0.9165**	0.2737	0.1035	0.2912	0.2804	0.2923	0.3604	0.1831	0.5001
EC4	0.4392	**0.9046**	0.305	0.0433	0.293	0.2475	0.3153	0.421	0.2197	0.557
EC5	0.497	**0.9117**	0.3294	0.1079	0.2554	0.2319	0.2706	0.4149	0.2564	0.5767
EC6	0.4461	**0.8546**	0.2082	0.1453	0.2586	0.2098	0.246	0.4639	0.2044	0.5176
ED1	0.4195	0.2579	**0.9322**	0.1581	0.3894	0.2811	0.2804	0.1888	0.1033	0.3597
ED2	0.4611	0.3152	**0.9019**	0.0373	0.3971	0.2531	0.2511	0.2568	0.0822	0.3758
ED3	0.4029	0.2772	**0.9486**	0.1297	0.4836	0.356	0.3074	0.2183	0.201	0.3248
EP1	−0.0482	0.0246	0.1064	**0.9333**	0.306	0.1671	0.1246	0.0281	0.2375	0.0365
EP2	0.0899	0.1427	0.0765	**0.8580**	0.1175	0.0747	0.1308	0.1326	0.0996	0.082
EP3	0.0844	0.1156	0.1237	**0.9688**	0.2567	0.1892	0.1825	0.1277	0.213	0.0851
EP4	0.1363	0.1748	0.1384	**0.9292**	0.1913	0.216	0.1598	0.129	0.1441	0.1348
EVP1	0.0723	0.2435	0.2704	0.3046	**0.7587**	0.1771	0.2028	0.1116	0.2256	0.153
EVP2	0.1056	0.2742	0.3674	0.2416	**0.8676**	0.2827	0.2992	0.2001	0.3266	0.1161
EVP3	0.1487	0.2433	0.2727	0.1425	**0.7421**	0.2681	0.3006	0.193	0.2263	0.1656
EVP4	0.1578	0.3076	0.4659	0.1711	**0.7570**	0.2959	0.4083	0.17	0.3069	0.1836
EVP5	0.1208	0.2395	0.3478	0.1481	**0.8128**	0.3403	0.3128	0.1506	0.3016	0.0949
EVP6	0.0763	0.2139	0.2985	0.1886	**0.7790**	0.1847	0.127	0.2695	0.2398	0.1118
EVP7	0.2087	0.249	0.524	0.1649	**0.8015**	0.244	0.2297	0.213	0.2671	0.2201
IEM1	0.4056	0.4185	0.2866	0.2251	0.114	**0.7053**	0.337	0.3005	0.129	0.3731
IEM2	0.368	0.4188	0.2971	0.2093	0.1118	**0.7314**	0.3182	0.2985	0.1527	0.3229
IEM3	0.3354	0.3736	0.2482	0.2589	0.2062	**0.8050**	0.3083	0.308	0.185	0.3265
IEM4	0.385	0.3261	0.3682	0.1575	0.2037	**0.7943**	0.2513	0.2486	0.1528	0.3543
IEM5	0.0509	0.1113	0.1423	0.0523	0.3152	**0.7963**	0.1893	0.0069	0.2481	0.1297
IEM6	−0.0137	0.0099	0.248	0.0868	0.3658	**0.7812**	0.1879	−0.0153	0.2017	0.08
IEM7	0.0346	0.0762	0.2498	0.0686	0.3324	**0.7996**	0.1759	0.0404	0.199	0.0977
IR1	0.3219	0.4024	0.2594	0.2393	0.1833	0.2523	**0.7969**	0.1671	0.0966	0.2595
IR2	0.1025	0.1577	0.2682	0.0752	0.3717	0.2814	**0.9162**	0.1019	0.1927	0.1252
SE1	0.4522	0.4187	0.2315	0.1059	0.2203	0.2157	0.1067	**0.9560**	0.1087	0.4529
SE2	0.4654	0.4197	0.2429	0.1069	0.2372	0.1894	0.1424	**0.9737**	0.1473	0.4425
SE3	0.4252	0.5077	0.1971	0.0929	0.2154	0.1301	0.1724	**0.9271**	0.1117	0.4528
SP1	−0.0217	0.185	0.0909	0.1636	0.255	0.1152	0.2095	0.062	**0.8622**	0.0726
SP2	0.0326	0.1931	0.0961	0.098	0.2431	0.1307	0.1843	0.1074	**0.8759**	0.1411
SP3	−0.0097	0.1806	0.1702	0.1834	0.4072	0.2661	0.1202	0.1246	**0.9407**	0.1255
SP4	−0.01	0.2274	0.1591	0.2237	0.424	0.3107	0.1408	0.1447	**0.9114**	0.1366
SP5	−0.0207	0.1197	0.1269	0.1561	0.2888	0.2365	0.1517	0.0211	**0.8832**	0.0838
SP6	0.0598	0.2114	0.181	0.2186	0.2352	0.2628	0.1675	0.1022	**0.8345**	0.1419
SP8	0.1313	0.2722	0.0505	0.1355	0.1771	0.0903	0.111	0.2488	**0.7345**	0.2792
SS1	0.3607	0.4799	0.3238	0.06	0.1694	0.2323	0.143	0.4047	0.0952	**0.9074**
SS2	0.3735	0.5413	0.3274	0.1093	0.2119	0.2869	0.1597	0.4117	0.176	**0.9493**
SS3	0.4982	0.5438	0.389	0.1101	0.1599	0.3057	0.2401	0.4731	0.1829	**0.9456**
SS4	0.4938	0.5987	0.3497	0.0705	0.1708	0.2586	0.2366	0.4956	0.1055	**0.9416**
SS5	0.4454	0.5764	0.3646	0.0429	0.1546	0.2155	0.1807	0.4193	0.1442	**0.9233**

there are significant differences for ED ($t = -3.326$, $p = 0.001$) and SE ($t = -2.071$, $p = 0.041$), however, further analysis using chi-square test showed no significant differences in ED ($\chi^2 = 15.139$, $p = 0.299$) and SE ($\chi^2 = 13.283$, $p = 0.275$) amongst the early and late respondents. Hence, it can be concluded that non-response bias did not pose a material problem in this study.

5.2. Structural model evaluation

The results as presented in Table 5 shows that IEM, IR, ED and EC are positively and significantly related to sustainability performance with T-statistics value of greater than 1.96 and P-value lesser than 0.05. SS and SE, on the other hand, do not have a significant relationship with sustainability performance (with a T-statistics value of less than 1.96 and P-value greater than 0.05). In-

Table 4
1st order discriminant validity.

	CC	EC	ED	EP	EVP	IEM	IR	SE	SP	SS
CC	***0.9071***									
EC	0.4869	***0.8778***								
ED	0.4555	0.3025	***0.9278***							
EP	0.0629	0.116	0.1219	***0.9232***						
EVP	0.1604	0.3209	0.4625	0.2474	***0.7894***					
IEM	0.2479	0.2818	0.3271	0.1803	0.3256	***0.7742***				
IR	0.2187	0.2939	0.3047	0.1619	0.3414	0.3106	***0.8586***			
SE	0.4705	0.4688	0.2359	0.1072	0.2359	0.188	0.1472	***0.9524***		
SP	0.0209	0.2258	0.1483	0.1968	0.3449	0.241	0.1777	0.1299	***0.8654***	
SS	0.4638	0.586	0.3757	0.0881	0.1875	0.2824	0.2058	0.471	0.156	***0.9336***

Table 5
Structural model evaluation.

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	*p*-value	Findings
H1: Internal environmental management -> Sustainability performance	***0.2058***	***0.2136***	***0.067***	***3.0718***	***0.0021***	***Significant & positive***
H2: Cooperation with customers -> Sustainability performance	***−0.2452***	***−0.212***	***0.1152***	***2.1288***	***0.0333***	***Significant but negative***
H3: Investment recovery -> Sustainability performance	***0.1526***	***0.1605***	***0.0666***	***2.2912***	***0.022***	***Significant & positive***
H4: Eco design -> Sustainability performance	***0.2823***	***0.2738***	***0.0718***	***3.9312***	***0.0001***	***Significant & positive***
H5: Supplier selection -> Sustainability performance	−0.0763	−0.0703	0.0917	0.8319	0.4055	Insignificant
H6: Environmental collaboration -> Sustainability performance	***0.2395***	***0.2327***	***0.0797***	***3.0035***	***0.0027***	***Significant & positive***
H7: Supplier evaluation -> Sustainability performance	0.1374	0.1248	0.0966	1.4226	0.1549	Insignificant

Table 6
RMSE mean of ANN model.

Input: IEM, CC, IR, ED, EC.
Output: SSP

	Training			Testing			
Neural network	N	SSE	RMSE	N	SSE	RMSE	Total
ANN1	161	2.645	0.1282	17	0.235	0.1176	178
ANN2	160	2.597	0.1274	18	0.384	0.1461	178
ANN3	160	2.337	0.1209	18	0.186	0.1017	178
ANN4	160	2.549	0.1262	18	0.253	0.1186	178
ANN5	160	2.370	0.1217	18	0.324	0.1342	178
ANN6	160	2.472	0.1243	18	0.270	0.1225	178
ANN7	160	2.369	0.1217	18	0.208	0.1075	178
ANN8	160	2.356	0.1213	18	0.274	0.1234	178
ANN9	160	2.509	0.1252	18	0.130	0.0850	178
ANN10	161	2.455	0.1235	17	0.247	0.1205	178
		mean	0.1240		**mean**	0.1177	
		SD	0.0027		**SD**	0.0169	

Table 7
Relevance of reflective independent variables in ANN model.

	Number of non-zero synaptic weight in the connections of predictor variables with hidden neurons.					
Neural network	PM	ES	IS	CO	ER	IA
ANN1	3	3	3	3	3	3
ANN2	3	3	3	3	3	3
ANN3	3	3	3	3	3	3
ANN4	3	3	3	3	3	3
ANN5	3	3	3	3	3	3
ANN6	3	3	3	3	3	3
ANN7	3	3	3	3	3	3
ANN8	3	3	3	3	3	3
ANN9	3	3	3	3	3	3
ANN10	3	3	3	3	3	3

terestingly, CC is significantly but negatively related to sustainability performance.

Next, artificial neural network (ANN) analysis was performed using SPSS v22 to complement PLS-SEM analysis which was firstly utilised to find out the statistically significant reflective independent variables that impact a reflective dependent variable, and these significant reflective independent variables are then treated as input neurons for the resultant output neuron (which is the reflective dependent variable) in the ANN analysis. ANN is very much like PLS-SEM in the way that it is flexible and does not need to fulfil multivariate assumptions such as normality and linearity (Leong, Hew, Lee, & Ooi, 2015).

Root Mean Square of Error (RMSE) for every ANN was computed to assess the predictive accuracy of ANN. Since lower RMSE value represents higher predictive accuracy and better data fit (Hew, Badaruddin, & Moorthy, 2017), hence the ANN model developed in Fig. 2 exhibits high predictive accuracy and good data fit in view of the low mean RMSE value for training (0.1240) and testing (0.1177) data as shown in Table 6. Besides this, the relevance of reflective independent variables in ANN model was evaluated by the number of non-zero synaptic weight connected to hidden neurons as demonstrated in Table 7.

Furthermore, the relative importance of each significant predictor was ranked in terms of normalised relative importance (%) by using sensitivity analysis as shown in Table 8. ED emerged as champion among the predictors of sustainability performance (with 100% normalised relative importance) followed by IR, EC, IEM and CC with 94%, 80%, 58% and 57% normalised relative importance respectively.

Only significant predictors are ranked as shown in Table 9. The ranking for PLS-SEM and ANN is according to the strength of Path Coefficient and Normalised Relative Importance respectively. The results are very interesting as IR is ranked number two in ANN but is ranked number four in PLS-SEM in terms of the strength of influence. This could be due to the nature of ANN which could capture both linear and non-linear relationships among the constructs (Oparaji, Sheu, Bankhead, Austin, & Patelli, 2017). That is to say, after capturing the non-linear relationship between IR and sustainability performance, IR is actually more important than EC

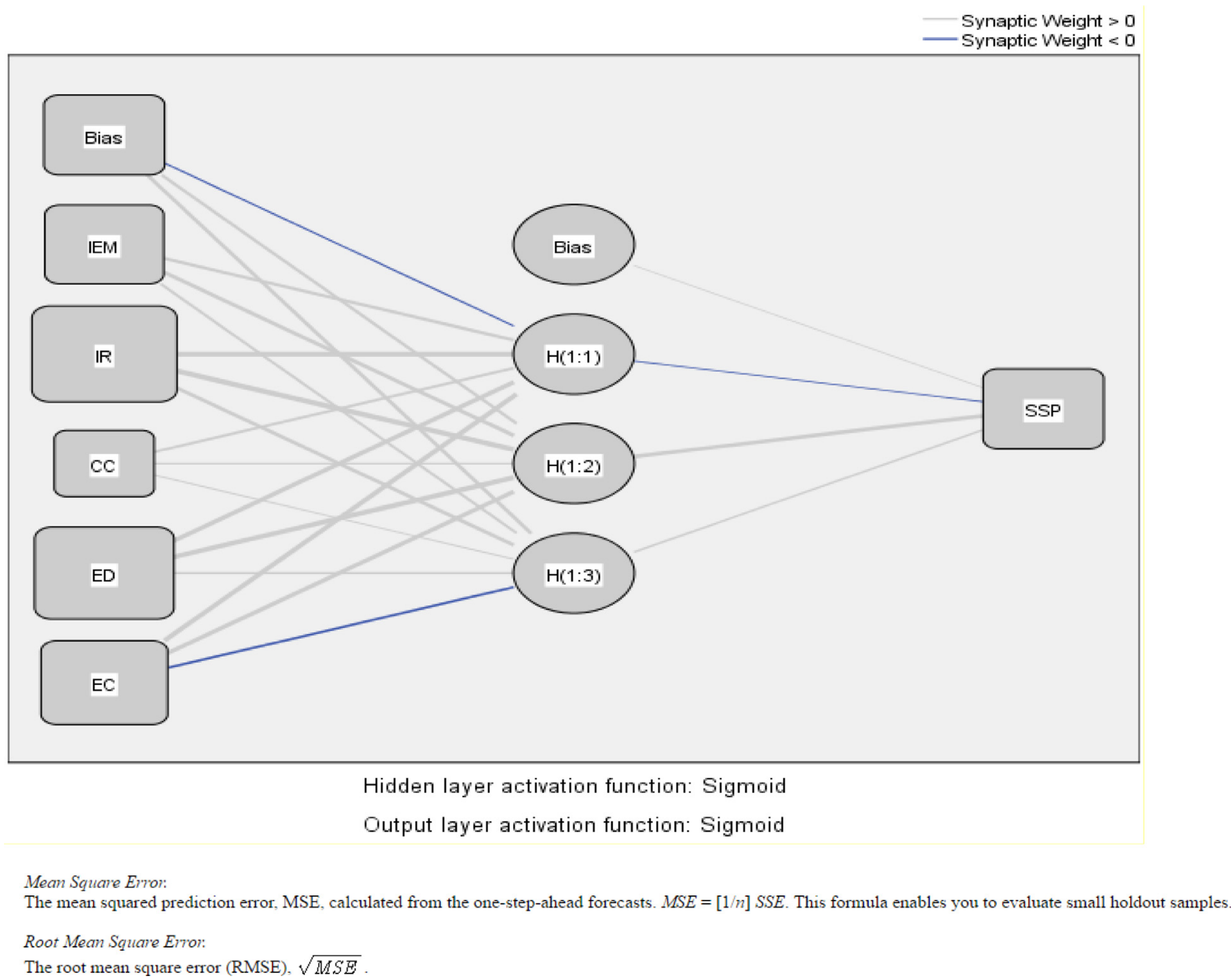

Fig. 2. ANN model developed.

Table 8
Relative importance ranking results.

Neural network	Relative importance IEM	IR	CC	ED	EC
ANN1	0.152	0.329	0.022	0.291	0.204
ANN2	0.103	0.182	0.222	0.252	0.241
ANN3	0.142	0.151	0.229	0.230	0.248
ANN4	0.249	0.338	0.014	0.234	0.164
ANN5	0.122	0.292	0.101	0.269	0.217
ANN6	0.193	0.239	0.092	0.227	0.250
ANN7	0.127	0.227	0.194	0.260	0.191
ANN8	0.119	0.223	0.226	0.248	0.183
ANN9	0.061	0.196	0.217	0.326	0.200
ANN10	0.232	0.251	0.137	0.233	0.148
Average relative importance	**0.150**	**0.243**	**0.145**	**0.257**	**0.205**
Normalised relative importance (%)	**58**	**94**	**57**	**100**	**80**
Ranking	4	2	5	1	3

and IEM. This truth would be buried if only a single stage of analysis (i.e. PLS-SEM) is used, and hence this showcases the worthiness of the two-stage analysis method (PLS-ANN) in this study.

6. Discussion

This study seeks to empirically investigate the relationships between green supply chain management (GSCM) practices and sustainability performance among large ISO14001-certified manufacturing firms in Malaysia. As shown in Table 5, IEM, IR, ED and EC influenced sustainability performance positively and significantly whereas SS and SE do not have a significant relationship with sustainability performance. Interestingly, CC has a significant but negative relationship with sustainability performance. Discussions regarding the results are presented as follows.

First and foremost, the results showing that IEM, IR, ED and EC having significant and positive relationships with sustainability performance are consistent with past studies (De Giovanni, 2012; Green et al., 2012; Rao & Holt, 2005; Singh & Trivedi, 2016; Wu, Wu, Chen, & Goh, 2014). This has proven that various value-added green initiatives such as having highly-committed management teams and environmental management system in place, selling or recycling scrap materials and/or redundant machineries which are beyond repair, designing green products which do not involve the use of banned/hazardous substances during manufacturing, as well as actively collaborating with suppliers to have cleaner production all lead to achievement and/or improvement of sustainability performance. All these efforts that aim to mitigate environmental and socio-economic footprints have undoubtedly yielded positive outcome that is evidenced by the statistical results that prove the positive and significant linkage between these GSCM practices and sustainability performance.

Interestingly, CC is significantly but negatively related to sustainability performance. This implies that an increasing level of CC will result in a decreasing level of sustainability performance. The outcome is in contrary to many of the past studies which advocate a positive and significant relationship between CC and com-

Table 9
Comparison between PLS-SEM and ANN results.

IV	Original sample (O)/Path Coefficient	Findings	Ranking (PLS-SEM) [based on Path Coefficient]	Ranking (ANN) [based on Normalised relative importance (%)]	ANN results: Normalised relative importance (%)	Matched or not
ED	0.2823	Significant & positive	1	1	100%	Matched
IR	0.1526	Significant & positive	4	2	94%	
EC	0.2395	Significant & positive	2	3	80%	
IEM	0.2058	Significant & positive	3	4	58%	
CC	−0.2452	Significant but negative	5	5	57%	Matched
SE	0.1374	Insignificant	N/A	N/A		
SS	−0.0763	Insignificant	N/A	N/A		

pany performance (in the dimensions of economic, environmental and social performances) such as the studies done by Diabat et al. (2013), Green et al. (2012), Van Hoek (2001), and Zhu and Sarkis (2004). This may be due to the firms are in the early stage of co-operating with customers for eco-design, cleaner production and greener packaging and huge initial outlay is involved and the advantages of economies of scale are yet to be reaped and hence resulting in negative economic performance due to increased operating costs (Zhu, Sarkis, & Lai, 2013). Furthermore, according to Perotti, Zorzini, Cagno, and Micheli (2012), the level of investment to manufacture greener products by using cleaner production techniques as a result of collaborating with customers has not yet been balanced by a corresponding improvement in company's performance. This is especially true for early adopters of GSCM practices. Besides this, the negative relationship between CC and sustainability performance may also be caused by the negative impact on economic benefits that far outweighed the positive impacts on environmental and social benefits, hence causing the negative relationship. Furthermore, Malaysia is considered as a developing country with an emerging economy when compared to economy giants like the USA and China that are relatively more developed and advanced in many aspects, including in GSCM development where esteemed researchers in the likes of Zhu, Sarkis and Lai and Green et al. being the world's pioneer researchers in the field of GSCM are hailed from USA and China. In addition, the different results might be due to different settings, demographic profiles and socio-cultural differences among the respondents.

On the other hand, it is rather surprising to find that there is no significant relationship between SS, SE and sustainability performance in this study; which is in contrary to past studies such as Caniëls et al. (2013), Hsu and Hu (2009), Kannan et al. (2014), Large and Thomsen (2011), Paulraj (2011), and Vachon and Klassen (2006). Interestingly, an empirical study performed by Luzzini, Brandon-Jones, Brandon-Jones, and Spina (2015) yielded similar results where intra-firm collaborative capabilities including cross-functionality of decision-making for supply market analysis, sourcing strategy, supplier selection and contracting, and supplier evaluation do not effect a significant relationship with cost (financial), environmental and social performances. In the present study, factors causing this insignificant relationship include the selection of suppliers may not be entirely based on the environmental competence and environmental performance of suppliers because it might have economic trade-offs (and hence bore down on economic performance) when it comes to triple-bottom-line review (Carter, 2005). This insignificant relationship may be attributed to a relatively smaller sample of firms that were implementing these practices (Wang & Sarkis, 2013). Furthermore, quite a number of firms responded that they do not regularly conduct environmental audits into suppliers' internal operations and neither do they conduct regular site visits to suppliers' premises to help the suppliers improve eco-performance. This finding provides a fresh insight into the relationship between a firm's upstream supply chain management with sustainability performance as a whole in the Malaysian context.

7. Conclusions

This empirical study mainly investigates the relationship between GSCM practices and sustainability performance among ISO14001-certified manufacturing firms operating in Malaysia as per FMM Directory 2015. A research model was formed linking the eight constructs, where all seven relationships are hypothesized as positive and significant. Upon performing statistical investigation using PLS-SEM analysis, 5 hypotheses are supported while 2 hypotheses regarding the linkage between SS, SE and sustainability performance are not supported. Hence, based on the findings of this study, it can be postulated that IEM, IR, ED and EC influence sustainability performance positively and significantly while there is no significant relationship between SS, SE and sustainability performance. CC on the other hand influence sustainability performance significantly but negatively. The rationales behind these findings are presented in the discussions section.

In response to RQ1, RQ2 and RQ3, the findings of this study show that GSCM practices (IEM, IR, ED and EC) are significant and positive predictors of sustainability performance whereas CC is a significant but surprisingly negative predictor. Among the significant predictors, both PLS-SEM and ANN show that ED has the most influence on sustainability performance whereas CC has the least influence on sustainability performance.

Zhu et al. (2008, 2013) mainly focused on the set of GSCM practices that encompass internal environmental management (IEM), green purchasing (GP), Cooperation with customers including environmental requirements (CC), eco design (ECO) and investment recovery (IR) and their associated impacts mainly on individual environmental/economic/operational/firm performances. On the other hand, Green et al. (2012) mainly focused on the impact of GSCM practices which comprised of internal environmental management (IEM), green information systems (GIS), green purchasing (GP), cooperation with customers (CWC), eco-design (ED), and investment recovery (IR) on individual DV which are made up of environmental performance (ENP), economic performance (ECP), operational performance (OPP), and organizational performance (ORP). The authors took few steps further by incorporating supplier selection, environmental collaboration and supplier evaluation in the set of GSCM practices to examine the impact of upstream supply chain practices on performance outcomes much more comprehensively and holistically. Besides this, the authors also explored the individual impact of each GSCM practice on sustainability performance as a whole where economic, environmental and social performances are examined as a multidimensional second order reflective construct, which is the objective of this study. Hence, in the authors' humble opinion, this is an exploratory study in which the research framework is new and not examined before.

In a nutshell, the research framework can be a useful source to future researchers because it had laid a good foundation in advancing the model related to green concepts. Besides this, the research framework is also an extended model of past studies (Paulraj, 2011; Zhu et al., 2008) and this model is one-of-a-kind because none of the past studies have "single-handedly" and simultaneously examined the effects of these specific GSCM practices on sustainability performance. Furthermore, the strength of each significant predictor of sustainability performance is being ranked by utilising ANN technique to further affirm the results analysed by PLS-SEM technique.

The research framework has the potential to serve as a powerful lighthouse that provides valuable insights and guidance on the eminently gigantic magnitude of individual impact initiated by the cocktail of selected elements of GSCM practices on the three dimensions of sustainability performance to industry practitioners who need to make decisions of varying degrees of importance and urgency at the operational, tactical and strategic levels.

Industry practitioners will then know which "blind spots" to zoom-in to in order to conjure up efficient and effective remedial solutions aimed at solving problems caused by ignorant, unethical or irresponsible staff who conveniently ignore the industry's best practices set forth by relevant authorities or establishments such as ISO. It is always better to be safe than sorry by complying with various mandatory and/or voluntary frameworks so as to streamline everyone's efforts to continuously strive for a better and more sustainable planet.

Several limitations are identified in this study and corresponding recommendations are suggested. First of all, this is a cross-sectional study where the researchers only collected data at one point in time. Future researchers may consider performing a longitudinal study that spans well over three years in order to better ascertain the direction and magnitude of causality among the research variables (Lee et al., 2015). Secondly, the present study employs a pure quantitative research technique (100% self-administered survey) where more in-depth responses as well as non-verbal communication data may be captured through qualitative or mixed research methods. Qualitative research techniques such as observation and in-depth interviews are seen as remedies to overcome some of the information deficits that quantitative case studies present (Goldstein & Drucker, 2006). Besides this, the 178 firms that participated in the actual study are involved in at least 14 different industries (as shown in Table 1 above). Hence, it is not feasible to analyze the sub-groups separately. Furthermore, the objective of this study is to investigate the impact of GSCM practices on the sustainability performance of all large ISO14001-certified manufacturing firms in Malaysia as per the Federation of Malaysian Manufacturers Directory 2015. One of the key advantages is that the results can be generalized across all industries (de Lange, 2016) and the set of GSCM practices possesses the capability to serve as fundamental standard operating procedures (SOP) or guidelines to achieve and even sustain sustainability performance among manufacturing firms not only in Malaysia, but in other emerging economies as well. Nevertheless, the authors would certainly analyze the sub-groups separately - like dividing primary activity of firms to traditional / local (paper products etc.) and new / global industries (electrical & electronics products etc.) and investigate the possible varying degree of impacts of each group on bottom-line in future studies. Besides this, the focus of this study is only on manufacturing firms and did not cover service firms that provide transportation and logistics services such as UPS, DHL and FedEx (just to name a few). In view of the significant CO_2 emissions caused by the transportation and logistics industry (Khan et al., 2018), researchers should certainly investigate the impact of the outbound logistics function of supply chains in future studies. Last but not least, the present study only focuses on Malaysian manufacturing firms. Future researchers may consider broadening the scope of study by extending the target research areas to cover more geographical areas such as other Asian, European, African and American countries to compare findings in developing and developed countries and also to enhance generalizability (Wong, Tan, Tan, & Ooi, 2015).

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix A

Table A.

Table A
Survey items.

[a]GSCM practices:	
[a]*Internal Environmental Management*	
IEM1:	"Commitment of GSCM from senior managers."
IEM2:	"Support for GSCM from mid-level managers."
IEM3:	"Cross-functional cooperation for environmental improvements."
IEM4:	"Total quality environmental management."
IEM5:	"Environmental compliance and auditing programs."
IEM6:	"ISO 14001 certification."
IEM7:	"Environmental Management Systems."
[a]*Cooperation with Customers*	
CC1:	"Cooperation with customers for eco design."
CC2:	"Cooperation with customers for cleaner production."
CC3:	"Cooperation with customers for green packaging."
CC4:	"Cooperation with customers for using less energy during product transportation."
[a]*Eco Design*	
ED1:	"Design of products for reduced consumption of material/ energy."
ED2:	"Design of products for reuse, recycle, recovery of material and/or component parts."
ED3:	"Design of products to avoid or reduce use of hazardous products and/or their manufacturing process."

(*continued on next page*)

Table A (*continued*)

[a]*Investment Recovery*	
IR1:	"Investment recovery (sale) of excess inventories/materials."
IR2:	"Sale of scrap and used materials."
*IR3:	"Sale of excess capital equipment."
[b]*Supplier selection*	
SS1:	"We select suppliers based on their environmental competence."
SS2:	"Suppliers are selected based on their ability to support our environmental objectives."
SS3:	"We select suppliers based on their technical and eco-design capability."
SS4:	"We select suppliers based on their environmental performance."
SS5:	"We select suppliers based on their ability to develop environmentally friendly goods."
[b]*Environmental collaboration*	
EC1:	"We cooperate with our suppliers to achieve environmental objectives."
EC2:	"We provide our suppliers with design specification that include environmental requirements for purchased items."
EC3:	"We encourage our suppliers to develop new source reduction strategies."
EC4:	"We cooperate with our suppliers to improve their waste reduction initiatives."
EC5:	"We work with our suppliers for cleaner production."
EC6:	"We collaborate with our suppliers to provide materials, equipment, parts and/or services that support our environmental goals."
[b]*Supplier Evaluation*	
SE1:	"We conduct regular environmental audits into our suppliers' internal operations."
SE2:	"We periodically evaluate our suppliers' environmentally friendly practices."
SE3:	"We make site visits to suppliers' premises to help them improve their eco-performance."
[c]Sustainability performance:	
[c]*Economic Performance*	
EP1:	"We have adequate sales and business volume."
EP2:	"We can produce at low cost."
EP3:	"We can make required profit."
EP4:	"Our sales growth is high."
[c]*Environmental performance*	
EVP1:	"We take adequate measures to control water pollution (e.g. effluent treatment plant (ETP))."
EVP2:	"We take adequate measures to control air pollution."
EVP3:	"We take adequate measures to control soil pollution."
EVP4:	"We recycle the wastes of our plant or sell the wastes to recyclers."
EVP5:	"We control the use of hazardous materials and chemicals (lead, Azo or other banned chemicals etc.) in products."
EVP6:	"We have environmental certification and audit."
EVP7:	"We fulfil the criteria regarding environmental legislation of the country."
*EVP8:	"We evaluate the environmental performance of suppliers."
[c]*Social performance*	
SP1:	"Our company provides standard wages and overtime payments."
SP2:	"Our company provides required benefits to the employees (e.g. leave benefit, medical benefit, child care facility, transportation, etc.)."
SP3:	"We take adequate precautions for hazards and safety of the employees (maintaining fire safety, building safety, personal protective equipment)."
SP4:	"We take adequate measures for health and sanitation of the employees (pure drinking water, cleanliness, adequate toilets)."
SP5:	"We are strict about the child labour issue."
SP6:	"We do not force to work and do not harass workers."
*SP7:	"We monitor the social compliance factors of our suppliers."
SP8:	"Our employees are satisfied with us."

* items dropped during path analysis because of low factor loading (<0.7).
[a] Source: Zhu et al. (2008).
[b] Source: Paulraj (2011).
[c] Source: Chowdhury (2014).

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