A holistic model of dynamic capabilities and environment management system towards eco-product innovation and sustainability in automobile firms

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Abstract

Purpose – Environmental pollution has emerged as a major concern in the 21st century following the introduction of sustainable development (SD) by the year 2030, whereby one of the predominant goals is related to the manufacturing industry. In Malaysia, the automotive industry is acknowledged as the backbone driving for economic growth and recognised as a source of environmental deterioration. Therefore, eco-innovation is, thus, introduced as one of the efforts for minimised environmental effects, reduced social impact and firm value sustenance. In particular, eco-product innovation is one of the renowned environmental innovation dimensions and displays high adoption and diffusion rates in developed countries due to green awareness and government financial assistance. However, developing countries such as Malaysia show relatively low adoption of such practices amongst companies, whereby most of the efforts are driven by the governments, supplier and customer demands. Therefore, this paper aims to delineate the factors of voluntary initiatives undertaken by the Malaysian automotive and auto parts industry towards eco-product innovation.

Design/methodology/approach – The research drew from the micro-level perspective, thus using dynamic capabilities (DC) constructs and environmental management system (EMS) strategy variables. The constructs included technology collaboration, green human resources and eco-culture, while the variables denoted formal EMS and top management support. Survey data were obtained from 242 entities within the Malaysian automotive and auto parts industry, which were subjected to analysis via confirmatory factor analysis and structural equation modelling.

Findings – The findings revealed the moderating role played by eco-product innovation for the association linking EMS strategy and sustainability development, while no moderator effects were observed between DC and sustainability development. Thus, future research can be performed in the meso and macro-level areas by using qualitative research across different sectors.

Originality/value – This paper explicates novel literature content, particularly for the field of eco-product innovation; it positions an empirical analysis from the micro-level perspective regarding the antecedence of DC and environmental strategy towards eco-product innovation and SD, mainly in the automotive industry.

Keywords Sustainability, Eco-innovation, Dynamic, Capabilities, EMS, Automotive-industry, Automobile

Paper type Research paper

1. Introduction

Sustainability is associated with unprecedented concerns early 21st century onwards from non-government agencies (e.g. the United Nations and other development agencies) and local governments aiming to save the earth via reduced thermal emissions and environmental pollution. In particular, knowledge-sharing and enhanced cooperation for creating and developing environmentally friendly products are amongst the key recommendations in the Global Sustainable Development (SD) Report (United Nations, 2019). In turn, the aforementioned knowledge-sharing activities stimulate the growth and development of sustainable initiatives via firm activities and planning undertaken, especially in the manufacturing landscape. Malaysia as one of the developing countries with rapid economic growth is highlighting the green efforts in support of SD, primarily in the automotive industry due to its role in national development. However, up to 30% of polluting gas emission is contributed by the manufacturing sector, including the auto industry (Maldonado and John, 2020) and waste generation. Therefore, the current trend nowadays in such nations extends beyond minimising the carbon footprint and complying with environmental regulations; they strive to respond and implement eco-innovation in the manufacturing process.

Eco-innovation is part and parcel of innovation activities; it is underpinned by the ultimate goals of minimised environmental

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Journal of Business & Industrial Marketing
© Emerald Publishing Limited [ISSN 0885-8624]
[DOI 10.1108/JBIM-04-2020-0217]

This work was supported by the Centre for Research and Innovation Management, Universiti Teknikal Malaysia Melaka (UTeM). The authors would like to thank all team members of the Centre of Technopreneurship Development UTeM for their direct and indirect contributions.

Received 24 April 2020
Revised 17 October 2020
25 February 2021
Accepted 1 April 2021

burden and better economic exchange, wherein targeted sustainability execution should be in both contexts of technology (i.e. product and process) and non-technology (i.e. organisation, marketing and institutional) (OECD, 2012; Rennings and Rammer 2011). It is further positioned as an element for sustainability attainment (Angelo *et al.*, 2012; Saunila *et al.*, 2019), specifically in manufacturing industries (Afshari *et al.*, 2020). Eco-innovation practices can be defined from low-level technology via incremental changes introduction or high-level technology by using radical production process changes or introducing new and sophisticated product development of various environmental effects. Therefore, their adoption is practical in the manufacturing industry following the varying practices in terms of different values positioned in technical and non-technological changes, as well as delineating their wide-ranging influence on economic, ecological and social development as shown in Figure 1.

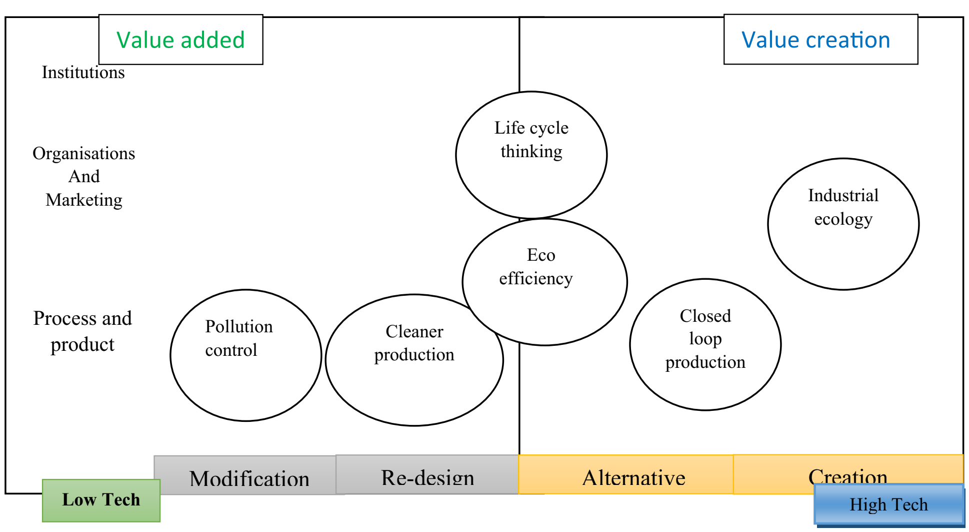
Eco-innovation is heavily considered by various researchers; it is responsible for SD due to its direct impact on reduced environmental pollution, economy development via value-added activity and value creation and the essential elements of social satisfaction. It is highly adopted by the automotive industry via novel technique introduction for waste management (Maroušek, 2014) and development of renewable energies (Ellabban, 2014), thus performed in terms of eco-product, eco-process and eco-management (Maldonado and John, 2020). Furthermore, Potter and Graham (2019) has confirmed the crucial role of supplier's electric and hybrid capabilities towards materialising eco-innovation co-patents amongst Japanese automakers and suppliers. Here, eco-product innovation is associated with a key function, mainly to the automotive industry, due to the pressure of regulations and market demand, as well as the need for saving the Earth and ensuring the future generation's needs. Per this, strong managerial commitment is considered the heart of its successful adoption in detailing the strategic direction of environmental reduction activities designed in companies and strengthening internal capabilities.

In recent years, growing research material on eco-innovation has explicated eco-product innovation practices adoption per selected industries and country settings. Most of the outcomes have substantiated the argument that its organisational adoption is driven by external pressure mainly from customers, market and government, as well as being a political agenda rather than voluntary effort. Therefore, the grey area of voluntary efforts and initiatives demands extensive attention on measuring the adoption practices in manufacturing companies, especially in the automotive industry (Maldonado and John, 2020). A robust outpour of literature currently discusses the drivers of external factors such as customer and government support in terms of valuable incentives towards such practices (Munodawata and Johl, 2019). Besides, some authors are keen to understand their adoption across several organisations having different industry settings due to minimal systematic research and empirical studies available on the relationships between the internal drivers of firms.

In particular, the capabilities required to successfully adopt eco-innovation either via technical or non-technical changes are unknown. Therefore, this research attempts to provide new knowledge by divulging the important elements of organisational capabilities to support eco-product innovation during new product development per Salim *et al.'s* (2019) recommendation. Such practices and their adoption are widely and globally well-known, underpinning the trend for "green" in product or lean process. Thus, this study is undeniably noteworthy in explicating current comprehension and contributing significant findings to the existing literature positioned by prior works. For example, studies by Salim *et al.* (2019), Dangelico (2017) and Cheng and Shiu (2012) are rooted in the automotive industry developing countries specifically.

Therefore, the research question for this paper reveals how the Malaysian automotive and auto parts industry successfully performing eco-product innovation and which factors, namely, DC, EMS strategy and eco-product innovation correlated to the SD. The articles adopted quantitative research and survey

Figure 1 Conceptual illustration of radical-incremental eco-innovation for sustainability development



Source: Adapted from Carrillo-Hermosilla *et al*. (2010), Machiba (2009), Hellström (2007) questionnaire send to the selected firm to represent the Malaysian automotive and auto parts industry. The survey questionnaire was designed to measure their implementation level of DC, EMS strategy and eco-product innovation as well as SD performance. Thus, the remaining sections are organised accordingly: Section 2 describes previous literature and the proposed hypotheses development, while Section 3 defines the research methodology. Then, Section 4 presents the data analysis and discussion processes, whereas the conclusions, limitations of future research direction are included in Section 5.

2. Literature review and relevant theory

2.1 Eco product innovation

Eco-innovation or environmental innovation is considered a component of innovation activities for environmental impact reduction towards achieving SD, thus linked with designing products posing no harm to the surrounding. This is achieved either during the development process via minimised usage of materials, energy and resources or through less-polluted product disposal. is less polluted. In particular, Fernando *et al.* (2019) have indicated that implementing eco-product innovation supports sustainable business performance. Accordingly, Hellström (2007) and Rennings and Rammer (2011) offer the following definition of product and process innovation: an entity equipped with integrated environmental technology following which both innovation types are implemented for the production of less environmentally hazardous products. This links the definition of eco-innovation and new product development while echoing the green product innovation framework by Dangelico and Pujari (2010).

Green product innovation or novel green product development typically involves three crucial types of environmental focus, namely, material, energy and pollution; its effects are seen across varying stages of the product life cycle (PLC), including the manufacturing process, product use and disposal. Firstly, the manufacturing process denotes material and energy resources being used via recycling, recyclable and biodegradable material or packaging used during process development. Energy efficiency is, thus, required in the process through renewable energy sources implementation. Pertaining to product use, eco-product minimises energy usage or product operations include renewable energy sources utilisation. Focus on pollution has encouraged cleaner pollution technology implementation by firms for less pollution during the production process or by-products generating less or not pollution on the environment. Accordingly, Dangelico and Pujari (2010) have pioneered green product studies and defined eco-product innovation as the development of products yielding low material and energy input for minimised production throughout the PLC, whether during manufacturing, usage or disposal stages. Thus, the proposed hypotheses denote:

H1a. Eco-product innovation will lead to a positive relationship for SD.

H1b. Eco-product innovation has a moderate effect on the relationship between dynamic capabilities and EMS strategy.

2.2 Dynamic capabilities

Dynamic capabilities (DC) is developed following several theories such as evolution economic, innovation-based competition, behavioural aspects, market hierarchy and role of specific firm assets (Ambrosini and Bowman, 2009; Teece and Pisano, 1994). Conceptually, it is derived from the resource-based view (RBV) theory due to the underpinning proposal by Barney (1991) merely offers a rudimentary indication. In fact, it lacks evidence on "how future valuable resources could be created or how the current stock of Valuable, Rare, Inimitable and Non-substitutable (VRIN) resources can be refreshed in changing environments". In general, resources and capabilities are traceable as varying identities; resource is an asset embedded in firms towards operationalising their activities explicitly across physical, human and organisational capital. Meanwhile, Grant (1991) has identified capability as an intangible resource due to its role in performing specific tasks or activities and addressing various indicators such as "core capabilities" to represent the company's strategic activities.

The main differences between DC and RBV theories are rooted in capabilities offering sustainability advantage, following DC being described as a "firm's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments" to win the market competition (Teece *et al.*, 1997). In particular, DC answers the generation of new "value creation activities" in firms via effective resource management through tailored strategy and organisational processes. Furthermore, Eisenhardt and Martin (2000) have justified its representation for organisational behaviour, namely, organisational asset and stock resources renewal for sustainable advantage. In contrast to conventional DC dependent on organisational routine (Leonard-barton, 1992; Teece *et al.*, 1997), its new concept delineates organisation-specific processes or "firm's best practice" (Bowman and Ambrosini, 2003; Eisenhardt and Martin, 2000) for effectual activity management. Eisenhardt and Martin (2000) have further agreed that managerial-level DC does not promise sustainable advantage; thus, firms should ensure effective resource base handling via "synergistic activities".

Furthermore, Ambrosini and Bowman (2009) have discovered DC development is possible reconfiguration, leveraging, learning and creative integration, as well as gaining and releasing resources per Eisenhardt and Martin's (2000) perspective. Therefore, this research describes its use as a tool for effective environmental effort management per the micro-level perspective. Per Hofmann *et al.* (2012), DC is crucial in carrying out organisational environmental innovation, whereby Hart (1995) and Johansson (2002) have described firm requirements to develop internal and external capabilities for successful environmental innovation. Moreover, Arranz *et al.* (2020) have delineated DC's inherent role in organisations to support firm innovation and sustainability, portraying its organisational function in the categories of technology collaboration, green human resource and eco-culture.

2.2.1 Technology collaboration

Technology capability is acknowledged in its role to drive innovation activities, whereby firms equipped with higher technological know-how will perceive enhanced economic growth. Here, Arnold and Thuriaux (1997) have reported that strategic, internal and external capabilities are deemed the core of technology capabilities to achieve a competitive edge. The automotive industry, in particular, has unique and complex managerial circumstances, requiring in-depth research in understanding the success factors, especially under new product development. Developing a product is a challenging task due to the integration of other auto part components and concurrent development processes, rendering it dissimilar to other processes, and thus recognised as a "problem-solving activity" (Brown and Eisenhardt, 1995). Here, innovation activities are continuously performed during the development process. According to Cui and Wu (2017), such a process is crucial for firm sustainability in meeting customer expectations. Therefore, a successful product development demands a meeting with customers and simulating their consumption via information flow spanning the development stages, production process and consumer feedback (users) (Alraggad and Onizat, 2020). This aligns with the attributes of the automotive industry itself, which is complex and requires effective management extending beyond internal integration towards external collaboration for improvement activities, especially in terms of Malaysia (Wad and Chandran Govindaraju, 2011).

The Malaysian auto industry embraces technology and knowledge transfer from suppliers (SA, Majid Rashid and Fasasi, 2012) following lacking benefits gained from the alliance and foreign direct investments (FDIs). It further acknowledges the customers as a hindrance in such transfer, influencing and guiding the quality improvement activities and green technology initiatives alike (Rashid and Shami, 2018). Besides, González *et al.* (2008) have detailed the notable effect of external capabilities as opposed to other elements in spurring technology transfer, especially for the industry (Conding and Habidin, 2013). Meanwhile, Hofmann *et al.* (2012) have described higher commitment for environmental management practices and life cycle analysis (LCA) due to inter-firm relationships. Close relationship between suppliers and customers, in particular, is crucial in positioning environmental initiatives via collaborative Research and Development (R&D) activities (Qian *et al.*, 2020) or knowledge distribution (Zhu *et al.*, 2008) and environmental regulation (Rehfeld *et al.*, 2007; Zailani *et al.*, 2012). Thus, the proposed hypothesis details:

H2a. The technology collaboration is positively related to eco-product innovation.

The automotive industry is associated with complexity due to the process of new car development consisting of effectual time, people and environment management. Therefore, technology collaboration is rooted in an efficient customer-supplier association for an improved eco-product innovation performance, which is especially pertinent in the industry (Rashid *et al.*, 2015). Accordingly, González *et al.* (2008) have reported that enforcing EMS regulations amongst automotive suppliers poses a positive correlation with environmental performance in triple line. They include environmental product design, minimised material usage and managerial aspects including in-depth prevention and safety systems. Besides, Zhu *et al.* (2008) have reviewed the customer-supplier collaboration between Chinese and the UK automotive industries and substantiated the direct effect of their strong cooperation on the environmental, economic and operational performances. Collaboration offers benefits via an understanding of consumer demands and environmental information can improve the environmental image and return-on-investment of a firm indirectly (Pujari, 2006). Therefore, technology collaboration between suppliers and customers is deemed important in spurring SD, resulting in the corresponding hypothesis:

H2b. Technology collaboration leads to a positive relationship with SD.

2.2.2 Green human resource

Technology collaboration notwithstanding, human resource is acknowledged as the fundamental basis in describing firm DC and sustainable advantage (Khan *et al.*, 2020). Its importance in substantiating strategic innovation (Chen and Huang, 2009) and organisational innovation has been extensively assessed, whereas minimum efforts on systematic research and empirical study are noted on green human resource management (Jackson *et al.*, 2011), especially in Asian countries (Renwick *et al.*, 2013). Human resource management is crucial requires effective managerial handling due to employees being the asset; the skills, knowledge and expertise inherently found in individual capital demand further development for work efficiency purposes. Furthermore, human capital should be disseminated and shared in collaborating and achieving firm goals and planned activities.

Besides, the core capabilities of green human management (GHM) underlines employee role as extremely crucial in achieving environmental enhancement per managerial orders (Gill *et al.*, 2021). GHM is linked with three primary themes to support eco-product innovation efforts such as environment-based product LCAs and design (Pujari, 2006). Here, training underlined as the root of green initiatives (Jabbour *et al.*, 2019), followed by performance-based rewards (Govindarajulu and Daily, 2004; Jackson *et al.*, 2011; Renwick *et al.*, 2013) and green team (Pujari, 2006). Therefore, a green human resource practice is a robust scholarly landscape in delineating its association with eco-innovation, resulting in the following hypothesis:

H3a. The green human resource is positively linked to eco-product innovation.

Human resource, in general, is instrumental for green technology innovation and SD purposes according to Jabbour and Santos (2008) and Bombiak and Marciniuk-Kluska (2018). Despite the lack of information for measuring the link between green human resource practices and eco-product innovation, much evidence has substantiated their effect on its performance. In fact, scholars have examined the direct impacts of green human resource practices for environmental performance, whereby Govindarajulu and Daily (2004) and Daily and Huang (2001) have described the importance of the human resource to improve firm commitment to environmental innovation and initiatives. Meanwhile, Cia and Li (2018) have underlined employee training as the key for minimised production waste and harmful material consumption. Ramus (2002), in contrast, has denoted firm capability in investigating alternative technologies, procedures and product quality and improving supplier commitment on environmental certification are important to support SD (Mousa and Othman, 2020). Thus, the following hypothesis is proposed as follows:

H3b. Green human resource leads to a positive relationship with SD.

2.2.3 Eco culture

Culture is recognised as organisational values and beliefs that are shared, thus guiding employee perceptions, attitudes and behaviour (Chen *et al.*, 2020). Accordingly, organisational culture is denoted the core ideation of DC's primary construct, allowing external absorption and internal integration in the development of the new product, innovation management and eco-innovation (Roscoe *et al.*, 2019). For example, Jackson *et al.* (2011) have identified the complementary nature of organisational culture with green human resource practices in substantiating environmental management programmes (Fernandez *et al.*, 2003) and employee eco-initiatives (Daily and Huang, 2001; Govindarajulu and Daily, 2004), which are heavily reviewed. The additional dimensions of eco-innovation culture have also been discussed by Ramus and Steger (2000) and Ramus (2001).

Transforming the company culture "from a rigid structure to supportive organisation" is essential to motivate environmental innovation and managers serve as the key person for grounding and facilitating employee participation in such efforts towards zero carbon emission and waste reduction (Govindarajulu and Daily, 2004). According to Taha *et al.* (2010), the success factor of eco-design and eco-product development in the Malaysian manufacturing industry is attributable to the organisational culture. In particular, eco-innovation has been identified as a complex activity towards achieving the triple bottom line effects as it requires a major overhaul for advanced technology implementation, employee behavioural changes and supportive organisational culture, respectively. Therefore, Pujari (2006) has emphasised the need to assess the cultural factors due to their importance for managers and the lack of empirical research in new product development and SD (Munodawafa and Johl, 2019; De Jesus and Mendonça, 2018). Therefore, the hypotheses are drawn as follows:

H4a. The eco-culture positively leads to eco-product innovation.

H4b. Eco culture has a positive relationship to SD.

2.3 Environmental management system strategy

In essence, the ISO 14000 series details 20 environmental standards of voluntary and process-based nature (Govindarajulu and Daily, 2004). According to Curkovic *et al.* (2005), it was developed in 1996 and denoted five main pillars, namely: commitment or policy, planning, implementation, measurement and evaluation and continuous improvement (Murmura *et al.*, 2018). Its cutting-edge attributes yield waste reduction, less energy and material consumption decreased distribution cost and enhanced firm image, thus offering a competitive advantage from the holistic management point of view. This will occur once firms are independent of profit-making from marketing strategies (Curkovic *et al.*, 2005; Petroni, 2001), meet the targeted performance or comply to government regulations.

Furthermore, ISO 1400 extends beyond improving the operational effectiveness while saving the world (Ferrante and Cotter, 1999); it is acknowledged as a tool for achieving sustainable competitive advantage, namely, by implementing physical capital resources, human capital resources and organisational capital resources (Nee, 2011). Its approach and concept are devoted to significant attributes of valuable, rare and inimitable resources, as well as a non-substitute resource (Wu *et al.*, 2008), especially in the manufacturing companies (Florida and Davison, 2001). Besides, an abundance of evidence has revealed its status as a valuable asset following its twofold benefits of tangible and intangible values via environment-saving steps and improved business performance. Accordingly, this research defines the EMS strategy in the form of formal EMS and top management support.

2.3.1 Formal environmental management system

Scholars have embraced EMS certification as a valuable, rare, imitable and non-substitute resource positioning a key role in support of firm green initiatives. Furthermore, scholars (Daily and Huang, 2001; Govindarajulu and Daily, 2004; Ramus, 2002) have proposed the significance of adopting concurrent practices such as EMS in firms to ascertain effectual employee eco-initiatives. The business competition landscape has extended beyond profit-based focus; it calls upon sustainable advantage in economic, ecological and social development at present. Therefore, EMS should be introduced as one of the incorporated approaches for enhanced environmental performance to achieve environmentally responsible firm management (Wu *et al.*, 2008). It is attributable for its critical role in bridging firm environmental innovation (Rehfeld *et al.*, 2007; Rennings and Rammer, 2011) and as a driver for environmental product design implementation, material usage reduction and management aspects, primarily in the automotive industry (González *et al.*, 2008). Thus, the next hypotheses are proposed as follows:

H5a. The formal EMS positively leads to eco-product innovation.

H5b. The formal EMS has a positive relationship with SD.

2.3.2 Top management support

Management support is crucial and not limited to the commitment and finance aspects; it extends into the formal regulation to support eco-innovation (Horbach and Rennings, 2013). Implementation of environmental policies such as the EMSs in the companies serves as a bridge to motivate the employees towards green production activities and a tool to drive eco-product innovation (Rehfeld *et al.*, 2007). EMS-certified firms are deemed highly productive in corporate environmental strategic implementation across environmental product design, material usage reduction and management aspects (González *et al.*, 2008).

Furthermore, worldwide EMS adoption positively affects operation performance in design, recycling and waste practices, whereas the tracking system adopted via environmental information and performance is highly associated with operation performance in terms of overall cost, lead time and product quality (Wu *et al.*, 2008). Accordingly, Sroufe (2003) has emphasised the role of environmental monitoring to support environmental practice in product design, allowing the conclusion that top management strategies towards the documentation and announcement of EMS certification are approved as a tool to encourage firm environmental innovation:

H6a. Top management support positively leads to eco-product innovation.

H6b. Top Management support has a positive relationship to SD.

3. Research design and methodology

This study illustrated the role played by DC and EMS on firm SD in the Malaysian automobile industry, as moderated by eco-product innovation. A survey was disseminated to 242 companies within the automotive and auto parts industry due to it being deemed the main driving engine for national growth (González *et al.*, 2008). However, their respective locations spanned from the east to west of Malaysia, which was underlined as one of the problems faced in reaching the potential respondents. Therefore, multistage cluster sampling selection was implemented following its convenience for selecting the right population and simplifying the data collection techniques. According to Hair *et al.* (2007), the sample can be divided into a sequence of steps; here, the sampling method implemented the criteria of the selected cluster per Kumar *et al.* (2013) recommendation:

- **Cluster one**: Selection of geographical areas within Malaysia per region (i.e. northern, central, southern, east coast and the region of Sabah, Sarawak and Labuan.
- **Cluster two**: Selection of a particular industry in each of the selections.
- **Cluster three**: Selection of companies within each selected area.

The survey data were obtained via a structured questionnaire emailed to suppliers and targeted collection during Proton and Perodua vendor briefings and green management training organised by the Malaysian Automotive Institute (MAI). The questionnaire was answered by the middle management personnel from selected departments equipped with information and in direct contact with environmental activities in their respective companies. Data for this research were collected from 242 respondents and co-variance-based SEM (CB-SEM) and regression hypothesis were both used to measure the proposed hypotheses. Several sections were included in the survey to assess and mediate the independent variables affecting eco-innovation activities and firm sustainability. Respondent evaluation is undertaken by using a seven-point Likert scale ranging from 1 (“I strongly disagree”) to 7 (“I strongly agree”), whereby the survey instruments and items are presented in Table 1 below.

Here, maximisation algorithm (EM) implementation via Statistical Package for the Social Sciences (SPSS) amplified the absent significance of present statistics. Done effectively, it would yield higher reliability and in-depth forecasting for the parameter assessment compared to other techniques such as cutting wisdom, which is significantly variable and replaces the reliable values with undervalued ones. Therefore, the model was proven experimentally by applying structural equation modelling (SEM), using AMOS version 22 with a maximal probability estimate. Besides, this study followed the process of building a two-stage model for the proposed SEM implementation (Hair and Black, 2010). To measure the moderating effects of EPI on the relationship between DC and SD, hierarchical regression was used (Cohen and Cohen, 1983). The utilisation of multiple hierarchical regression was superior in ascertaining the moderating effect of a variable for the link between factors. To guarantee the moderator effect availability, a three-step hierarchical regression was conducted and a similar procedure was replicated to gauge EPI’s moderating impacts on the link connecting EMS methodology and SD.

4. Result and analysis

4.1 Construct reliability and validity

The composite load factor was used for reliability confirmation, whereby the dissimilarity achieved would evaluate the convergent competencies (Fornell *et al.*, 1981). This work yielded factor loading exceeding 0.60 for all measurements as suggested by Chin *et al.* (2017). Furthermore, Table 2 depicts the compound reliability as the extent to which construction predictors for the underpinning structure ranging between 0.87 and 0.93, which exceeds the proposed value of 0.7. Meanwhile, the mean-variance (AVE) demonstrating the aggregate sum of parameter variation measured via passive construction ranged

Table 1 Measurement items for this research

Constructs	No. of items	Scale of measurement	Sources
Technology collaboration level	5	(7) High implementation (1) Low implementation	Hofmann *et al.* (2012), Conding and Fadly Habidin (2013), Pujari (2006) Qian *et al.* (2020) and Alraggad and Onizat (2020)
Green human resource	4	(7) High implementation (1) Low implementation	Daily *et al.* (2007), Theyel (2000), Digalwar *et al.* (2013) Cia and Li (2018), (Gill *et al.* (2021) and Jabbour *et al.* (2019)
Eco culture	4	(7) High implementation (1) Low implementation	Ramus (2001), Shatouri *et al.* (2013), (Roscoe *et al.*, 2019) and (Chen *et al.*, 2020)
EMS strategy	6	(7) High implementation (1) Low implementation	Digalwar *et al.* (2013), Sroufe (2003) and Wu *et al.* (2008)
Eco-product innovation efforts	6	(7) High existence (1) Low existence	Cheng and Shiu (2012) and Dangelico and Pujari (2010)
Sustainable development	5	(7) Strongly agree (1) Strongly disagree	Zailani *et al.* (2012), Daily *et al.* (2007) and Fernando *et al.* (2019)

Table 2 Reliability analysis

Items	Description	Standardised loading	Average variance extracted (AVE)	Construct reliability (CR)	Cronbach's alpha (CA)
Technology collaboration	Shares and exchanges environmental information with key component material suppliers	0.47	0.74	0.86	0.88
	Have a mutual understanding of environmental standard with customers	0.67			0.88
	Uses input from customers for eco-design	0.85			0.88
	Gathers input from customers for cleaner production/process optimisation (lowering resource input and output)	0.89			0.88
	Receives information from customers for environmental ideas of green products	0.85			0.88
Eco culture	Discusses mistakes so employees can learn for future endeavours	0.57	0.67	0.89	0.92
	Engages openly in discussions (e.g. on environmental topics) with employees	0.82			0.92
	Encourages employees to describe concerns regarding organisational environmental decisions and policies	0.95			0.91
	Listens to employees and values inputs on environmental topics from all organisational levels	0.91			0.91
Green human resources	Employees have the opportunities to implement environmental knowledge from training attended	0.62	0.71	0.90	0.908
	Employees practise cross-functional teams to improve environmental performance	0.88			0.906
	Employees practise cross-functional teams in initiating a green concept or idea	0.95			0.907
	Employees attend team meetings to discuss environment innovation activities	0.88			0.909
EMS strategy	Our organisation has a formal EMS	0.99	0.84	0.97	0.91
	Our organisation's EMS procedures are fully documented	0.99			0.90
	Our organisation's EMS procedures are widely circulated and available to anyone requiring access	0.98			0.90
	Our organisation has a mission statement explaining environmental commitment	0.85			0.91
	Our organisation's environmental performance is accurately tracked and presented in top management meetings	0.93			0.91
	Our organisation's environmental information is continuously tracked and monitored per the Environmental Health and Safety (EHS) department or person-in-charge	0.77			0.92
Eco product innovation	Our organisation emphasises simplifying the components of new products	0.49	0.56	0.88	0.87
	Our organisation emphasises using as little energy as possible for new products	0.50			0.87
	Our organisation updates the manufacturing process in preventing environmental contamination	0.77			0.87
	Our organisation implements novel technologies in the manufacturing process for save-saving purposes	0.93			0.87
	Our organisation updates equipment in the manufacturing process to save energy	0.93			0.87
	Our organisation underlines recycling systems into manufacturing processes	0.76			0.87
Sustainable development	Significantly reduces hazardous material consumption	0.45	0.74	0.90	0.92
	Significantly improves product quality	0.85			0.92
	Significantly reduces production costs	0.94			0.92
	Significantly instigates investigation for alternative technologies and procedures	0.88			0.92
	Significantly improves supplier commitment towards environmental certification	0.45			0.93

from 0.560 to 0.840, which exceeded the recommended value of 0.5 per Hair and Black (2010). Moreover, effective discriminant validity as the amplitude of the rate for whichever theoretical measures changed was assessed by matching the effective correlation between the square room value and the constructs of inequality obtained.

The investigative results reveal fewer correlations per construct versus the AVE square root through parameters measuring the constructs, demonstrating sufficient discriminating power as seen in Table 3. Three rules should be adhered to in measuring the extent of construct relation to other constructs, namely: MSV less than AVE, ASV less than AVE and the square root of AVE bigger than inter-construct correlation. All values obtained, thus denoted the lack of discriminant validity issues in this research.

4.2 Structural model analysis and results

Completion of the measurement model analysis allowed SEM assessment to be done, per Hair and Black (2010). Structural modelling is considered as the root of analysis due to the outcomes ultimately rely on the proposed model acceptance or rejection. It is basically depicted via a visual diagram, representing a set of one or more dependent relationships linking the hypothesised model's constructs. Besides, the structural or causal model is more practical and rigorous compared to traditional tests, as analytical performance will measure the direct and indirect effects of the exogenous construct (IV) and endogenous constructs (DVs). However, a GOF test should be done prior to drawing the concluding assumption for best fit structural model determination.

The primary goal of this work was the acquisition of strategic factor understanding towards aiding firm success for SD. It would identify those embedded within firms, enabling sustainability from the micro-level perspective as the outcomes are beneficial for benchmarking purposes via adopting a development model strategy. This research drew five exogenous variables (i.e. technology collaboration level, eco-culture, green human resource, formal EMS and top management support) to predict sustainability and eco-product innovation. Concurrently, eco-product innovation is critically crucial to enable sustainable firm development.

Armed with the aforementioned definition, the standardised parameter estimated in the structural model was for the antecedents of eco-product innovation and SD. GOF indices assessment indicated the hypothesised model befit the data sufficiently, with all fit indices showing reasonable values (X^2 = 616.093, df = 384, p = 0.00). Additionally, the values for GFI = 0.858; AGFI = 0.829; CFI = 0.961; TLI = 0.95; and RMSEA = 0.05 revealed the acceptable range for all fit indices, while six out of nine paths were significant with p values < 0.001, $^{**}p < 0.01$, $^{*}p < 0.05$.

4.2.1 Hypotheses testing results

Accepting or rejecting the proposed theories required two-fold boundary implementation for the parameter estimate (β) and critical value for regression weight (CR). The β value was used to quantify the assessed population co-variance matrix for the model (Tabachnick and Fidell, 2001). Cursory look revealed the CR value measurement increased the statistical power to determine the hypotheses testing and avoid error type II due to the effect size. Furthermore, Hair and Black (2010) have stated that the critical value selection is dependent on the theoretical substantiation for the positioned correlations. Hypothesising a positive or negative relationship allows the implementation of a one-tailed test of significance, whereby differences denote the critical t values used to assess the significance. At the 0.05 significance level, the critical value for the one-tailed test is 1.645. Thus, the previous argument is highly significant in substantiating the cut-off values for CR = 1.645 and acceptance of the statistically significant alpha level (p values $<$ 0.10) in concluding the proposed hypotheses.

Therefore, the dismissal of the three hypotheses is substantiated due to insignificant CR and p-value values as seen in Table 4. Underpinned by DC theory, *H4a* that explicitly measured the relationship between eco-culture and eco-product innovation was rejected (β = 0.0013, p = 0.82). Meanwhile, *H2a* and *H3a* were supported, indicating the positive relationship between technology collaboration level and green human resource with eco-product innovation at a significance level of $\beta = 0.204$, $p = 0.00^{***}$ and $\beta = 0.204$, $p = 0.00^{***}$, respectively. Besides, *H6a* was rooted in EMS strategy and measured the relationship between top management support with eco-product innovation, showing no significant relationship (β = 0.037, p = 0.606). As per *H5a*, formal EMS was positively related to eco-product innovation, which was significant at $\beta = 0.058$, $p = 0.07^{*}$.

Moreover, six hypotheses were proposed to predict SD, whereby three measured DC, two measured EMS strategy and one measured eco-product innovation. In particular, technology collaboration level (*H2b*), green human resource (*H3b*) and eco-culture (*H4b*) showed a positive impact towards SD, whereby the relationship was significant at $\beta = 0.12$, $p = 0.00^{***}$; $\beta = 0.144$, $p = 0.000^{***}$; and $\beta = 0.07$, $p = 0.08^{*}$); respectively. However, formal EMS yielded contradicting results with the initial hypotheses. Contrary to *H5b*, the positive

Table 3 Validity analysis

Constructs	CR	AVE	MSV	ASV	1	2	3	4	5	6	7
Sustain (1)	0.904	0.661	0.158	0.103	0.813						
Tech (2)	0.877	0.595	0.145	0.093	0.361	0.771					
Eco culture (3)	0.901	0.699	0.162	0.096	0.327	0.381	0.836				
GHRM (4)	0.909	0.718	0.162	0.106	0.397	0.329	0.402	0.847			
Formal EMS (5)	0.991	0.972	0.324	0.067	0.114	0.102	0.152	0.057	0.986		
Top (6)	0.918	0.789	0.324	0.135	0.370	0.283	0.312	0.352	0.569	0.888	
Eco product (7)	0.882	0.569	0.086	0.060	0.269	0.293	0.200	0.289	0.177	0.221	0.754

Notes: Remarks: AVE = Average variance construct, MSV = Maximum share variance, ASV = Average shared variance

Table 4 Hypotheses testing

Predictor variable	Criterion variable	Hypothesis	Estimate β	S.E.	C.R.	p	Results
Technology collaboration	Eco-product innovation	*H2a*	0.204	0.06	*2.65*	0.00***	Supported
GHRM	Eco-product innovation	*H3a*	0.204	0.07	*2.69*	0.00***	Supported
Eco-culture	Eco-product innovation	*H4a*	0.013	0.05	*0.73*	0.82	Not supported
Formal EMS	Eco-product innovation	*H5a*	0.058	0.03	*1.96*	0.07*	Supported
Top management support	Eco-product innovation	*H6a*	0.037	0.07	*0.11*	0.60	Not supported
Eco product innovation	Sustainable development	*H1a*	0.075	0.042	*2.00*	0.07*	Supported
Technology collaboration	Sustainable development	*H2b*	0.128	0.04	*1.72*	0.06**	Supported
GHRM	Sustainable development	*H3b*	0.144	0.04	*2.05*	0.00***	Supported
Eco-culture	Sustainable development	*H4b*	0.07	0.04	*1.67*	0.08*	Supported
Formal EMS	Sustainable development	*H5b*	−0.03	0.02	*−1.44*	0.18	Not supported
Top management support	Sustainable development	*H6b*	0.173	0.05	*2.39*	0.000***	Supported

relationship between formal EMS and SD was unsupported at $\beta = -0.03$, $p = 0.18$. Meanwhile, *H6b* was consistent with results indicating that top management support positively influenced SD at $\beta = 0.173$, $p = 0.000^{***}$). Finally, the results supported H1a, whereby eco-product innovation resulted in positive SD at $\beta = 0.07$, $p = 0.07^{*}$).

4.3 Moderator analysis

4.3.1 Moderating effect of eco-product innovation on the relationship between dynamic capabilities and sustainable development

This research proposed environmental product innovation as a moderating variable between DC and SD, driving EPI's contingent effect between the predictor and criterion and modifying the relationship. To measure its moderating effects on the said relationship, hierarchical regression was used per Cohen and Cohen (1983). Multiple hierarchical regression was found superior in ascertaining the moderating impact of a variable on the correlating relationship.

To guarantee the moderator impact's presence, a three-step hierarchical regression was done, whereby the first step measured the IV (i.e. DC) effect. The second step included the moderator variable (i.e. eco-product innovation) to assess its significance of the impact on the DV (i.e. SD), while the third step included the interaction terms (DC * eco-product innovation) to indicate the excess variance explained.

Next, Table 5 clarifies the moderating impact of EPI on the correlation linking DC and SD. The third step should denote notable R^2 increment with significant F-change value to ensure moderator effect. The table revealed a diminished R^2 model 3 value (0.106) in contrast with model 1 (0.194). Thus, the R^2 decrement detailed EPI's lack of moderating impact on the correlation linking DC and SD, rejecting the null hypothesis.

4.3.2 Moderating effect of eco-product innovation on the relationship between environmental management system strategy and sustainable development

To guarantee the moderator impact's presence, the third step required monumental R^2 increment with notable F-change value; Table 6 shows the increased R^2 model 3 value (0.108) in contrast with model 1 (0.098). Accordingly, the R^2 increment revealed EPI's positive moderating impact on the link between EMS procedure and SD, accepting the null hypothesis. If a noteworthy moderating variable impact is available, Aiken *et al.* (1991) have suggested the use of plots for every applicable interaction, which is superior in ascertaining the interactional moderating impact in the link between EMS and SD.

Table 6 depicts a significant difference in the moderating effects linking EMS strategies with SD. The increment of R^2 from 0.098 to 0.108 denoting the relationship between them indicated EPI's role as a moderating variable in this research. Meanwhile, R^2 decrement from 0.194 to 0.106 between them indicated the lack of moderating correlation in the relationship.

5. Discussion and conclusion

5.1 Theoretical implication of the study

Conclusively, this research provides crucial theoretical implications. Firstly, it extends the micro-level perspective by investigating individual efforts as the adopters of specific

Table 5 Result of the moderating variable between DC and SD

		Standardised coefficient B			
Model	**Variables**	**Model 1**	**Model 2**	**Model 3**	**Hypotheses**
Model 1	DC	0.410			
Model 2	EPI		0.251		
Model 3	DC*EPI			0.325	
R^2		*0.194*	*0.063*	*0.106*	Not
Adjusted R^2		0.152	0.059	0.102	supported
F		44.33	16.197	28.33	
ΔR^2			0.093	0.043	
ΔF			28.133	12.133	

Notes: $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

Table 6 Result of moderating variable between EMS and SD

		Standardised coefficient B			
Model	**Variables**	**Model 1**	**Model 2**	**Model 3**	**Hypotheses**
Model 1	EMS	0.313***			
Model 2	EPI		0.251***		
Model 3	EMS*EPI			0.328***	
R^2		0.098	0.063	0.108	Supported
Adjusted R^2		0.094	0.059	0.104	
F		26.05	16.19	28.94	
ΔR^2			0.035***	0.045***	
ΔF			9.86***	12.75***	

Notes: $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

innovation contrasting the macro-level assessment. Thus, further understanding and new knowledge about DC theory antecedents supporting eco-product innovation towards SD are obtained, particularly of the Malaysian automotive industry. Furthermore, it measures empirically selected variables to represent internal firm capability, namely, technology collaboration, green human resource and eco culture to represent a key measurement for organisational implementation in leveraging eco-product innovation implementation during new product development.

Concurrently, this work underlines EMS strategy as an internal weapon encouraging firm commitment towards adopting eco-product innovation and successfully achieving SD. Here, eco-product innovation conclusively led to positive sustainability development (*H5*), supporting previous literature by Carrillo-Hermosilla *et al.* (2010), Hellström (2007) and Tariq *et al.* (2017). They have asserted that eco-advancement, especially eco-item advancement, assumes a huge function in the current era to position SD in the triple bottom line (i.e. nature, economy and social). The Malaysian car industry particularly observes rising eco-development pertaining to new product component simplification and minimal energy for new products; updated manufacturing processes, equipment and novel technologies for lesser environmental effect and energy-saving; and recycling implementation in the production processes. This underlines Dangelico and Pujari's (2010) model of green product innovation due to the local automotive industry embracing the energy and pollution aspects during the manufacturing and disposal phases in developing new products.

Furthermore, the outcomes support prior literature denoting the industry's excellence in executing eco-efficiency via green or sustainable manufacturing, green supply chain and eco-design, wherein a positive link between technology collaboration with SD and eco-design is noted. Akhtar *et al.* (2019) have denoted the superior collaboration with suppliers for tacit and explicit knowledge transfer, thus enhancing the operational effectiveness via product quality and cost production. Additionally, the relationship with clients aids in minimising hazardous material implementation (Zhu *et al.*, 2008) due to their consistent support for suppliers in generating information regarding process optimisation and green product environmental ideations (Pujari, 2006).

Moreover, green human resources within green team formulation allow more attention for SD and eco-product innovation adoption. Haddock-Millar *et al.* (2016) have stated the presence of organisational green team underpins consistent activity enhancement and driven employee actions (Govindarajulu and Daily, 2004), leading to superior operational and ecological execution, particularly in pollution prevention (*P2*), pollution control and waste reduction.

In a nutshell, employment or human factors provide a substantial impact on environmental innovation in terms of materials and energy saving (Horbach and Rennings, 2013). The Malaysian automotive industry embeds green human management in training, similar to superior environmental innovation rather than rewards and recognition. This aligns with Ling (2010), whereby rewards and recognition yield a low relationship with the process, product and administrative innovation following cost minimisation and economic downturn.

The positive correlation between eco-culture and SD was denoted in *H4b* in this study. Superior top management support in spurring employees in communicating their worries regarding organisational environmental decisions and policies is crucial, particularly for the local automotive industry for increased operational effectiveness and minimised hazardous material implementation. Moreover, discussing past errors is paramount in preventing repetitive occurrences, allowing learning and executing innovative activities via Total Quality Management, lean administration, 5S and other top-notch improvements for better financial, environmental and social.

Aside from improving the cycle and item execution (Ramus, 2002), contributions from all pieces of the association are important to accomplish the economic advancement particularly for upstream and downstream gracefully chain (Eltayeb and Zailani, 2009) as expanding providers duty towards natural accreditation. Despite the fact that the absence of importance in the connection of formal EMS and economic improvement is somewhat astounding, there has been proved in the examination writing to help this finding. This finding is aligned with Wu *et al.* (2008) as physical capital resources such as formal EMS and procedure cannot guarantee sustainable competitive advantage as opposed to human and organisational capital (Nee, 2011) as it is easy to be imitated (Barney, 1991). It also agrees with Ramus (2002) as "having a written policy in itself does not make a company proactive or sustainable. Rather, it is a necessary prerequisite for SD". Implementation of TQM approved as the heart of tangible factors comprising quality training. Process improvement and benchmarking do not create economic value in the long term.

The results from this study confirm that top management support towards environmental reduction is embedded in three significant attributes such as drawing a mission statement that explains firms' commitment towards continuous improvement, pollution prevention and compliance assurance confirmed by Ferrante and Cotter (1999). EPI plays a significant role as a moderator variable between EMS strategies with SD. The findings are also aligned with Ramus' (2002) results as "having a written policy in itself does not make a company proactive or sustainable. Rather it is a necessary prerequisite for SD". Therefore, this study sheds question on eco-item advancement research in a creating nation setting and by implication, invigorates information development through observational proof of the part of eco-item advancement as a mediator variable. Besides, as confirmed by Rehfeld *et al.* (2007), the implementation of eco-product innovation improved sustainable performance, mainly the organisation with EMS certification.

Secondly, this research highlights the fact of the mentioned interaction from the perspective of a developing nation. Apparently, many studies have been drawn under the umbrella of SD, especially within the organisational context in western data. However, it should be presumed that findings derived from western data cannot be applicable in another region of the world such as Asia, particularly in Malaysia. It is as most of the environmental innovations from the western countries are dominated by radical innovation (Schiederig *et al.*, 2012) relative to incremental innovation undertaken by most of the developing countries. In particular, the driving engine for developing countries rests on manufacturing activities via effective and efficient operations management.

In this new era, however, green efforts have emerged worldwide and scholars and managers are extremely keen to learn about the constructs that implied high impact on the success of firms' voluntary efforts especially using their capabilities regardless of the origin of the country setting. In line with this, this study could be a fertile ground under eco-innovation research and SD. Even though some empirical evidence is conducted in the Malaysian setting, the reports only give a rudimentary indication of the state of green manufacturing, green supply chain and eco-design in relation to firms' performances. As this study was conducted in a specific industry, the results could be generalised to other developing countries such as Thailand and Indonesia.

In a similar fashion, the strategy of model development is useful and could be benchmarked for incremental innovation to describe the antecedents and outcomes of SD. The findings are also prone to support the previous argument which indicated that internal integration in terms of green human resource, eco-culture, formal EMS, top management support with external integration such as technology collaboration play a pivotal role towards SD. Also, eco-product innovation acts as a good moderator as supported in the previous literature. To conclude, the findings fulfilled the knowledge under empirical evidence on the green product innovation framework developed by Dangelico and Pujari (2010) in terms of antecedents for product focusses on energy and pollution through the manufacturing process and disposal stages.

5.2 Practical implication for managers

This research identifies a set of factors that are crucial for managers' practical consideration in supporting firms' voluntary efforts on managing environmental innovation. In an attempt to achieve environmental efforts, managers are encouraged to embrace technology collaboration with external expertise on both sides, suppliers and customers. Having strong collaboration with both parties benefits the companies not only in the long term but also could help companies in problem-solving related to environmental matters. As the automotive industry is built up from a complex and variety of upstream supply chains, suppliers are considered as the heart of the mechanism to support green initiatives. Therefore, managers should encourage knowledge sharing and exchange to enable environmental information with key component material suppliers.

In the same fashion, customers also play a pivotal role in influencing environmental behaviours, especially in developing countries. Thus, managers must put efforts in working closely with customers to reveal the unique requirements and respond accordingly to handle the environmental challenges in a proactive way as dealing with environmental matters during new product development brings a special concern from customers. As practised at Honda (M) Sdn Bhd and DRB Hicom Sdn Bhd, both organisations organised New Honda Circle (NHC) and Quality Improvement Team (QIT) competitions to evaluate innovation ideas through teamwork performance. This initiative could be implemented in eco-innovation activities as well as the ideas and the achievement are occupied in a triple helix. Both efforts are recognised as part of firms' capabilities to support eco-product innovation and SD, especially for the Malaysian automotive industry, as investing in greening the employees seems like a priority in any firm.

Besides, the managerial implication can be traced from the culture change. On the one hand, eco-culture has no positive relationship with eco-product innovation. However, it has a significant impact on the triple helix performance. Environmental innovation is not only dealing with changes in product or process but also with types of organisational behaviour and top management perception. Managers must show their commitment to environmental efforts by cultivating innovation and risk-taking culture and implement non-hierarchical culture. Basically, company direction is per a strong connection between employees and managers in which employee behaviour is influenced directly by managers' actions. Therefore, it is vital for managers to encourage their employees to express concerns about the firm's environmental decisions and policies. Open discussion with employees regarding previous mistakes and environmental topics with all departments via formal or informal meetings are approved as strategic tools to inculcate positive culture towards environmental perceptions in the long run.

This study also sheds light on the importance of EMS as firms' strategic resources enable SDs well as eco-product innovation. The findings draw a conclusion that managers should have a formal and well-documented EMS and available to employees in an attempt to signal to the employees about the company's commitment towards pollution reduction. Having an EMS certificate does not only increase the brand of the companies itself but also improves the level of environmental management and employee awareness. To conclude, achieving a sustainable competitive advantage requires top management support in terms of a clear mission statement about environmental commitment with proper designing of environmental tracking and information. Thus, managers should design robust environmental programmes and also allocate competent employees to handle environmental issues.

5.3 Research limitation

Generally, every finding drawn from the research is exposed to several limitations, including this research. Firstly, this research is prone to common method bias as the data collection procedures rest on sole respondents. However, to overcome this, the preventive steps such as asking respondents from various departments from one company to measure the predictor and criterion variables reduced the significant problem in this study. Secondly, the survey is biased towards the manufacturing rather than service industries, as the selection of respondents is derived from MAI, Proton and Perodua databases. Moreover, it could be a different perception and level of environmental innovation between the companies as it is moderated by firm size. Hence, the conclusion for this study is meaningful as it represents an insight into small and large firms on the implementation of green initiatives, mainly by Malaysian manufacturing companies.

The third limitation is related to the generalisation of the findings and conclusion as of a country setting. This research is a general study comprising the manufacturing sector under the automotive industry in Malaysia and cannot be generalised by western countries, especially those involved in radical innovation. Thus, the findings of this study are prone to be drawn without including the specific requirements and antecedents that affect the inclination of firms to perform eco-initiatives per specific sectors within the automotive industry. However, by applying this method, it has provided a holistic point of view from several key sectors comprising of metal parts, engine or transmission, plastic parts, E&E, rubber parts and other auto part components. Therefore, the information is fruitful to be applied by the managerial level, as it acquired an understanding of the predictors and outcomes of manufacturing firms that have embarked on SD via implementing incremental eco-innovation.

Finally, the limitation of this study rests on the methodology used, namely, the adoption of quantitative research and SEM analysis. This study has used a single methodology, which is quantitative research instead of either qualitative or mixed-method. The weakness of quantitative study relies on data collection procedure as measurement bias occurred if the respondents failed to understand the questions and cannot get immediate clarification. Consequently, the questions remain empty and lead to the wrong conclusion, as well as statistical error. Hence, to remedy this problem, the preliminary investigation has been performed to segregate completed and non-completed questionnaires and evaluate the case of missing value using SPPS. On the other hand, the nature of quantitative research yields generalisability. At the end of this research, the researcher is keen to generalise the findings rather than providing a deeper understanding of the situation or behaviour. In the same fashion, the usage of SEM as a tool for data analysis incurred reducing the statistical power due to the requirements of a larger sample size.

5.4 Signpost for future research

The limitations in the previous section are meant to open doors for future research investigation. Thus, this section discusses the recommendation embedded into three types of valuable prospects, namely, future research scope, research design, as well as construct measurement. At first glance, this research is fruitful in clarifying our understanding of the antecedents and outcomes of firms' environmental efforts from an incremental innovation perspective. However, new research could measure radical innovation either in the form of an open or closed-loop system. There are more studies conducted in western countries compared to eastern countries. Thus, new insights provided by the developing countries are recommended, as major research is derived from developing countries' pillars under green manufacturing, green supply chain, green purchasing and eco-town. To date, there is no conclusive evidence on Malaysian research under green or eco-product management underlining radical innovation is performed, as there is little evidence of radical innovation occurring and a lack of sampling frame to trace the respondents. Besides, this research provides insights into technical eco-innovation, and therefore new studies could seek clarification on the antecedents and outcomes for the non-technical eco-innovation, namely, marketing innovation, organisational innovation and institutional innovation.

Future research should also attempt to replicate this study by applying different research methods in terms of research design or data analysis. The qualitative or mixed-method approach is more practical to study radical innovation in Malaysia. Nowadays, mixed methods promise valid and reliable findings and have embraced popularity in new decades. On the one hand, qualitative research can be used to ascertain the local meaning attributed to the constructs and gauging a deeper understanding of the environment. Meanwhile, the quantitative approach is suitable on testing the hypotheses and provides data through empirical evidence. Also, the selection of suitable tools to analyse data is important to guarantee a robust conclusion. For qualitative methods, grounded theory or case study via using Atlas ti or Nvivo could be meaningful to analyse the data. Furthermore, the adoption of PLS-SEM (Smart PLS software) is more effective to handle various variables with complex relationships and no theoretical ground. Finally, this research emphasises on the usage of old and new tools to analyse moderator variables. Previously, hierarchy regression analysis was used to measure the moderator effects. However, in the latest development, this step is substitute\se both tools in generating accurate results.

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