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Pursuing green growth in technology firms through the connections between environmental innovation and sustainable business performance: Does service capability matter?

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ABSTRACT

In response to greater environmental awareness among stakeholders, companies have become increasingly interested in practices such as eco-innovation. Despite the expanding literature on eco-innovation, scholars have so far paid little attention to the study of eco-innovation and its impact on business sustainability, particularly considering the mediating effect of service innovation capability. To fill this research gap, this study extends the concepts of green business by investigating an original conceptual framework, which proposes that the capacity for service innovation has a mediating effect on the relationship between sustainable organizational performance and environmental innovation. This conceptual framework is subjected to empirical testing, implemented through a survey involving 95 Malaysian firms which use green technology. Data is collected through both postal and online questionnaires and analyzed through structural equation modeling using partial least squares. Respondents for this paper were identified using the directories of MyHijau (2013) and the Malaysia External Trade Development Corporation, 2014. The results suggest that: (1) eco-innovations unlock better sustainable performance; (2) service innovation capability has a partially significant positive mediating effect; (3) service innovation capability ultimately benefits companies by allowing them to differentiate through an emphasis on value creation; (4) service capability can also act as a business strategy to create barriers to new entry by competitors. Thus, eco-innovation and service innovation capability tend to represent significant intangible resources and enable an organization to achieve long-term objectives, competitive advantage and business sustainability. To date, this is the first study relating eco-innovation, service innovation capability and sustainability performance in the Malaysian corporate context and using a specific sample of companies that make use of green technologies.

1. Introduction

The purpose of this paper is to examine the mediating effect of service innovation capacity between eco-innovation practices and sustainable business performance from both the resource-based view (RBV) and the knowledge-based view. This work is anchored in the idea that green growth cannot be achieved without promoting green innovation (Kunapatarawong and Martínez-Ros, 2016). Additionally, a logical linkage between the resource-based view (Wernerfelt, 1984) and the knowledge-based view (Dess et al., 1995) is adopted in this research to elucidate the conceptual research framework. The resource-based view theory (Wernerfelt, 1984) considers the firm to be a unique grouping of capabilities and resources that combine to constitute competencies. One of the typical drivers of competitive advantage is innovation, which can stimulate the amalgamation of resources and capabilities to generate more sophisticated competencies (Bakar and Ahmad, 2010). One of the firm's most relevant resources, according to RBV, is knowledge (Villasalero, 2017). Knowledge is a basic requirement that must be possessed by a company in order to continuously innovate and thus improve the quality of products and services on an on-going basis. The knowledge possessed by the company is derived from (and based on) the expertise of employees, who are a vital component of the company's resources and are necessary to compete successfully in a knowledge-based market. Knowledge can be used to

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explore the best alternatives in designing new green products and services that can meet a company's objectives and satisfy the requirements of environmentally and ethically conscious customers. In this paper, eco-innovation is conceptualized as green activities that optimize internal resources to improve a firm's capacity to produce new green products and services, through compliance with environmental needs and by means of green technology, by working together in a cross-functional team that utilizes supplier involvement and is based on market requirements for business sustainability. Eco-innovation is a key element in many emerging concepts around sustainable manufacturing, such as world-class sustainable manufacturing systems (Dubey et al., 2015a,b) and green supply chain practices (Zhu and Sarkis, 2007). The literature argues that eco-innovation is able to unlock firms' performance (Eiadat et al., 2008). Eco-innovation practices in companies tend to be related to innovation in services, which are designed based on green knowledge and market requirements (Kandampully (2001)).

In Malaysia, eco-innovation is a concept embedded within the concept of green technologies. Green technologies have become a key aspect of the Malaysian green growth strategy. In this context, the government of Malaysia has established GreenTech Malaysia, a not-for-profit agency, as a focal point for green technology development and as the official national agency with the responsibility for promoting environmentally friendly technology. This agency explains that such technology constitutes those systems, products and equipment which can contribute to the preservation of environmental resources. Other gauges of green technologies are those which reduce environmental damage and emission of greenhouse gases, promote the sourcing and application of renewable resources, conserve natural resources and energy, are safe to use, and improve the health and sustainability of the environmental context for all forms of life which depend on it (GreenTech Malaysia, 2013). Based on Malysia's national policy on environmentally friendly technology policy, this aspect should become a driving force in stimulating the Malaysian economy and encouraging sustainable growth in the country (New Straits Times, 2013). Under the auspices of GreenTech Malaysia, many firms have targeted green technology as a strategy because of the impact these firms have on the environment and because these firms have begun to identify innovative and increasingly effective green production methods. Malaysia can be considered relevant to this research area as it is among the top 30 global economies, as well as being one of the leading emerging economies. Its economy will continue to grow over the next decades (PriceWaterhouseCoopers, 2015).

Eco-innovation assists firms in using eco-efficient practices in their production activities and requires knowledgeable staff to develop, organize, execute, control, and monitor cost savings for the benefit of the business (Song et al., 2012, 2018a; Song and Wang, 2018). Knowledge building and the sharing of common green best practices for eco-efficient production between a company and its suppliers helps to optimize decision-making to maximize resources. If a firm is oriented towards green innovation activities, this will provide better ability to solve business operations issues, and new ideas related to green innovations can provide better service to customers. In this study, the solutions provided by eco-innovation activities mostly relate to services, which are intangible in nature. The outcomes of eco-innovation activities can improve service innovation capability. Such capabilities are usually generated by innovation activities which emerge from new ideas that are developed to solve customers' problems (de Hertog et al., 2010). Therefore, environmental innovation not only improves a firm's competitive position based on knowledge and novel initiatives in the services it offers, but can also help a firm become more socially and environmentally responsible in general.

The research question driving this work can be expressed as follows: What mediating effect does service innovation capacity have on the relationship between sustainable organizational performance and environmental innovation practices, from the perspectives of the resource-based view and the knowledge-based view? In terms of related research objectives, it is possible to propose:

- To develop a research framework exploring the mediating effect which service innovation capacity has on the relationship between sustainable organizational performance and environmental innovation practices, from the perspectives of the resource-based view and the knowledge-based view.
- To discuss the results of research into the experience of a sample of Malaysian firms.

This study is distinct from others in the field because it is concerned with knowledge creation with respect to eco-innovation for enhancing service innovation capabilities, rather than with the adoption of technology. This unique aspect is relevant because, despite the extant eco-innovation literature, some business managers remain unaware of the positive outcomes of eco-innovation for business sustainability. In order to overcome this knowledge-related barrier, scholars and the Malaysian government should reinforce the value of developing eco-innovation within Malaysian companies to ensure the achievement of national carbon emissions targets. This empirical study may help companies recognize the positive outcomes of the development of eco-innovation and suggest related best practices that may be adopted by other companies. To achieve successful implementation of eco-innovation, each company must develop unique strategies to utilize its particular set of resources that others might find hard to replicate. Thus, from the technology-adoption perspective, other companies might replicate or adopt the same new technology without creating innovation. This suggests that this research may encourage companies to pursue the genuine potential advantages of eco-innovation for them.

The contributions of this research can be summarized as:

- Searches of scientific databases, such as Scopus and ISI Web of Science, clarified that there has been no similar study already published. Nevertheless, the relationship between eco-innovation and sustainable performance, mediated by service innovation is shown to be paramount.
- Additional research – as evidenced by the results of this study – is necessary in order to verify the impact of eco-innovation on the sustainability performance of companies in emerging economies. This may strengthen sustainability policies driven and supported by scientific data, improving the quality of decision-making processes in such countries.
- This research proposes an original framework anchored in the resource-based view and knowledge management theories and tests it through an original survey of Malaysian companies. To date, this is the first research dealing with a specific sample of companies that have been using green technology in Malaysia.

This paper is divided into six sections. This first section provides a brief description of the motivation for writing the paper, and the remainder of the paper proceeds as follows. Section 2 considers the relevant literature and sets out the hypotheses of this study. Following this, the methodology and the results of the analysis are presented in Sections 3 and 4. Section 5 presents a discussion of the results and implications for theory and practice. Finally, our conclusions are presented in Section 6.

2. Research background

The resource-based view and the knowledge-based view are used in this study to examine the effect of eco-innovation implementation on sustainable business performance among green technology companies in Malaysia. The resource-based view, initially introduced by Wernerfelt, 1984, considers the firm to be a unique combination of capabilities and resources which together generate competencies. Innovation constitutes one of the key drivers of an organization's

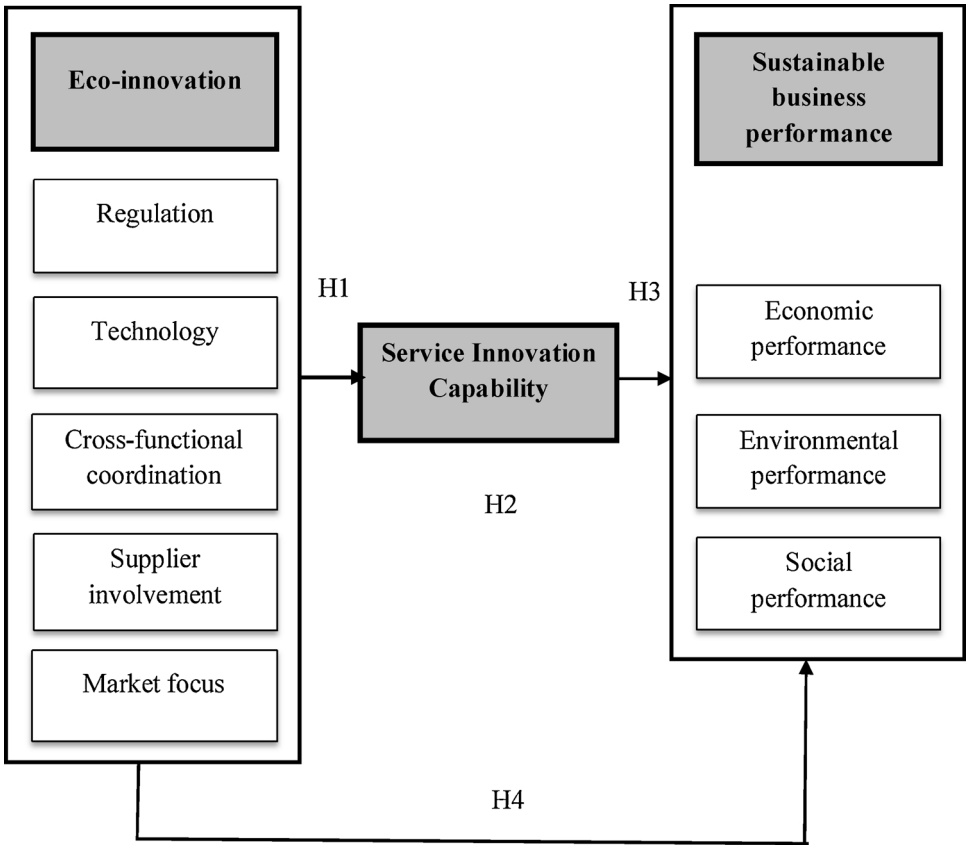

Fig. 1. Conceptual Research Framework.

competitive business advantage, as part of a grouping of resources and capabilities which together generate more sophisticated competencies (Bakar and Ahmad, 2010). Meanwhile, the knowledge-based view asserts that knowledge functions as a particularly distinctive resource that provides insights into the competitive dynamics of the firm (Kogut and Zander, 1992). The knowledge-based view highlights the non-observable knowledge-based factors that may directly affect a firm's performance (Dess et al., 1995). From the perspective of the resource-based view, eco-innovation has strengthened service innovation capabilities, which constitute an important intangible resource and are both valuable to the organization and challenging for other firms to replicate. In the long run, eco-innovation and service innovation capabilities enable a firm to achieve competitive advantage and sustainability. Fig. 1 (below) shows the conceptual research framework.

2.1. Green growth and eco-innovation practices

Green growth generally represents a kind of prosperity which is defined as quality-oriented, based on low-carbon initiatives and energy efficient actions, with a focus on creating value through new clean technologies, as well as through natural infrastructure and innovation, mainly in emerging economies (Vazquez-Brust et al., 2014). Under this concept, eco-innovation is considered a protagonist. Eco-innovation derives from the sustainable development concept (OECD, 2008), comprising innovation that contributes to the advancement of sustainability (Li et al., 2017). Hence, those firms which invest in eco-innovation are attempting to set themselves apart from their competitors in terms of environmental efficiency, whether this is in regard to their general eco-friendly performance or the impact of a specific product (Andersen, 2008). Additionally, eco-innovation may be implemented for reasons apart from potential reductions in negative impacts, such as to improve understanding of environmental change on the global scale and its effects on social and economic and systems (Rennings, 2000), or to increase the yield of resources (OECD, 2009). Firms' implementation of environmental innovation is vital in the effort to generate a shift towards sustainability in both business and society (Pujari, 2006). According to El-Kassar and Singh (2018), eco-innovation is an essential component of energy saving, pollution prevention, and waste recycling initiatives. Environmentally sound innovations can also explain why some countries are greener than others (Song et al., 2018b). To unlock green innovation, emerging technologies – such as big data – will be critical success factors (Song et al., 2018c).

2.2. Eco-innovation and service innovation capability

In the age of knowledge, developing and delivering effective service innovation and technology convergence has become a major strategy for firms to create and deliver better value for customers (Chen et al., 2007). Mele (2009) posits that innovation is the development of innovative value propositions that provide solutions to customers' needs through a combination of goods, services, systems, processes, and technologies. The way in which businesses add value to their products and services plays a crucial role in improving the innovation process for environmental impact (Stahel and Jackson, 1993). Innovation has been directly associated with economic growth and often occurs as a result of environmental destruction. As awareness of the importance of the environment for future generations has risen, so too has the concept of eco-innovation (Bossle et al., 2015), and eco-innovation has been practiced to assist companies in using equipment in a more environmentally friendly way when creating products and services.

The knowledge embedded in eco-innovation practices can improve a firm's ability to increase its service innovation capabilities. Service innovation capabilities should be able to cater for customers' needs as well as the environmental requirements of a firm's business model. Scholars have discussed sustainable business models that focus on the delivery of a "function" to customers (Mont, 2002; Williams, 2007) by

integrating products and services that are capable of fulfilling customers' needs (Goedkoop et al., 1999a,b). Function can be defined as a transformed product produced to add value that can be offered to the market. Services that come together with products are often connected with the idea of servitization, a strategy which is useful for enhancing service innovation capabilities. Servitization occurs when traditional manufacturing firms offer service-oriented products, and this can help differentiate companies which use green technology from those which do not, thus enabling them to achieve competitive advantage (Tongur and Engwall, 2014).

Eco-innovation practices require support through cross-functional coordination to improve the service innovation capability of a particular firm. Values, needs and desires of customers must be effectively communicated between the various managers and branches of an organization, as well as being informally communicated between the organization's staff (Grawe et al., 2009). This process is called cross-functional coordination. Firms that proactively exchange information and in which departments communicate with each other support the improvement of the organization's capabilities (Teece, 1998). Consequently, firms with effective communication are poised to react to variations in their customers' requirements, as well as to develop novel products and services (Day, 1994). Specifically, Kandampully (2001) argues that a firm's ability to consider issues from their customers' perspective and thus exceed customers' expectations is one important aspect of service innovation. Managers should have the ability to think about what a customer really needs. The foremost companies in service industries initiate innovative services to attain customer expectations, gain competitive edge, and transform the context of the market (Kandampully (2001)).

Furthermore, the technological aspects of service innovation have produced extensive debate in the relevant literature (de Hertog et al., 2010). Green technology plays a critical role in supporting the implementation of eco-innovation, which is linked to a firm's ability to improve its service innovation capability. While service innovations are conceivable without involving technological innovations, the two often go hand-in-hand. However, not all information technologies can develop and facilitate service innovations (de Hertog et al., 2010). In order to successfully apply green technology in the company, a firm should have the knowledge and skills of competent employees. The successful implementation of eco-innovation should integrate environmental and operational knowledge. Kearns and Sabherwal (2006) argue that knowledge integration is an important aspect of the knowledge-based theory for firms. In fact, the primary reason for the existence of knowledge-based firms is their superior ability to integrate multiple knowledge streams for the application of existing knowledge to tasks and for the creation of new knowledge (Grant, 1996). Successful knowledge integration requires that the individuals concerned possess an underlying foundation of shared common knowledge, domain knowledge, and mutual knowledge (Kearns and Sabherwal (2006)). Indeed, knowledge comprises one of the most important strategic resources of a firm and is a fundamental basis for competition (Grant, 1996). The knowledge-based view examines the knowledge surrounding what a firm does, how and why that knowledge is created, and what is done with that knowledge in terms of the main factors which allow a firm to succeed (Zack, 2003).

Eco-innovation practices in firms' operations should be based on customer requirements and comply with environmental regulations. Organizations which have a strong market orientation tend to seek competitive advantage through prioritizing the establishment and conservation of value for their customers (Olson et al., 2005). In introducing a new service concept, de Hertog et al., 2010 note that a key dynamic capability is the way in which service innovation is managed beyond the borders of the firm, through engagement in and management of wider networks. Usually, firms combine different service suppliers that together fulfill a service need (Ramirez, 1999). Hence, a service provider must co-design and co-produce a service innovation with other suppliers to ensure efficiency (de Hertog et al., 2010). Eco-innovation practices in a company should be able to create products and services shaped by green knowledge and market requirements. To this end, the outcomes of eco-innovation can improve the service innovation ability of a firm, not only to advise customers on green products but also to promote cleaner production to other manufacturing companies as part of addressing environmental matters and lowering production costs. Hence, this study posits that:

H1. There is a positive and significant relationship between eco-innovation and service innovation capabilities.

2.3. Sustainable business performance and environmental innovation

In order to build a direct link between sustainable business performance and environmental innovation, this study must first discuss the concept of sustainable business performance itself. Being aware of hazardous impacts on the environment and society, companies must find the best way to ensure that their production activities meet sustainability requirements. Two considerations should be given priority when defining sustainable business performance. One is that business sustainability on the one hand refers to a firm's ability to make profits to ensure long-term survival. The other is that business sustainability is also connected to the ability of the organization to deliver products or services based on processes or technologies that do not harm the environment or the overall health of society. In other words, one main outcome of a sustainability strategy is that a company will be able to stay in the market longer by maximizing internal and external resources for the best financial yields.

Sustainable business practices are a main interest of all current and future stakeholders because these practices help ensure the long-term health and survival of the business and its associated economic, social, and environmental systems (Landrum and Edwards, 2009). Many firms are struggling with the paradox of redirecting their attention from the traditional single objective of financial performance to strategic performance, which also involves social and environmental sustainability. There are three performance metrics that need to be considered as key outcomes of business sustainability. The first is financial sustainability, which refers to the ability of the organization to provide for its needs now and into the future. The second is social sustainability, which comprises the development and fulfillment of people's needs and the maintenance of social relationships that will thrive in the long term. The third is environmental sustainability, which refers to the protection and renewal of the biosphere for present and future generations (Pava, 2007). Scholars have argued that all three of these are equally important for a firm (Jones and Kramer, 2010).

The reasoning behind the proposed relationship between eco-innovation and sustainable business performance is based on several considerations. The eco-innovation principle encourages firms to use raw materials efficiently, which leads to lower production costs and provides additional revenue (Porter and Van der Linde, 1995). Eco-innovation practices assist a company in the best use of resources to achieve desired outcomes. Optimal use of resources will drive a company to improve its competitiveness and to differentiate itself from its competitors. The resource-based view postulates that unique capabilities derived from internal and external resources provide sustainable competitive advantage (Laosirihongthong et al., 2014).

The European Commission (2010) asserts that the discussion in this area is shifting towards the ways in which organizations can improve the financial and environmental value of their services and products through technology usage and innovation. Firms practicing eco-innovation should boost their cash flow and, consequently, enhance their business performance (Eiadat et al., 2008). Products which are created through environmental innovation deliver environmental and social benefits to consumers, which can further stimulate demand (Kammerer, 2009). Chen et al. (2006) argue that environmental innovation can

allow firms to improve the productivity of resources, and thus balance increased environmental costs. Using data obtained from the American manufacturing industry, Carrion-Flores and Innes (2010) identify a significant positive link between environmental performance and environmental innovation. Furthermore, Pujari's (2006) research into the development of environmentally friendly original products demonstrates that environmental innovation activities result in positive impacts for business performance.

The proposition of five environmental innovation constructs (technology, regulation, cross-functional, market focus and supplier involvement) has provided support for its direct link with sustainable business practices. During the last four decades, regulation has been the most important policy instrument related to the environmental behavior of entire sectors of the economy (Montalvo and Moghayer, 2011). Currently, the majority of empirical research shows that the role of regulation with respect to innovation and competiveness at the firm level is positive (Wagner and Llerena, 2011; Montalvo, 2012). Regulations have been created to encourage firms to adopt sustainability strategies and thus improve their sustainable business performance, which includes economic, social, and environmental performance (Pusavec et al., 2010). Hart and Ahuja's (1996) study states that comparing the relationships between environmental and business performance across industries with different technologies and product life cycles (e.g., electronics versus pharmaceuticals) is both important and instructive. Wagner and Llerena (2011) claim that, in order to achieve board-level responsibility for sustainability, larger companies include technology as part of eco-innovation at the corporate level.

Pujari (2006) found that environmental product solutions occur when cross-functional coordination takes place with the clear leadership and active support of the company's top management. Although the relationship between cross-functional integration and the success of new products is complicated, a direct relationship exists between integration and new product success, which leads to improved business performance (Troy et al., 2008). Little research accounts for concurrent supplier involvement with respect to sustainable design activities, because different suppliers each have their own level of sustainability (Olson et al., 2011). However, Teece (2007) indicates that new products fail to develop when the suppliers of new technology do not properly manage their understanding of customers' needs and wants. Carrillo-Hermosilla et al. (2010) emphasize user behavior as playing a crucial role in the implementation of environmental innovations and the societal impact in which they result. Consequently, one of the key factors influencing the market performance of greener products is market focus (Pujari, 2006). Eco-innovation can be implemented when a firm invests adequate resources to learn and generate technical expertise based on knowledge. The knowledge gained through such a learning process creates uniqueness for firms that competitors find difficult to imitate. The implementation of eco-innovation will therefore not only benefit companies financially, but also meet environmental requirements and contribute to societal wellbeing. Thus, this study proposes that:

H2. There is a positive and significant relationship between eco-innovation and sustainable business performance.

2.4. Sustainable business performance and service innovation capability

Under the resource-based view, one use of resources is the creation of capabilities which can lead to improved performance outcomes. Indeed, a crucial aspect of applying the resource-based view is being able to identify the optimum organization of resources and to continuously cultivate pre-existing capabilities, as well as to create new innovative capabilities (Leonard, 1992; Bergfors and Larsson, 2009). This study hopes to verify a significant link between service innovation capabilities and sustainable business performance. The literature suggests that service innovation capabilities act as a method for an organization to differentiate itself from its competitors by offering superior value (Salunke et al., 2013). Additionally, service innovation capabilities also help to satisfy end-consumers and increase profit levels (Oliva and Kallenberg, 2003). Lawson and Samson (2001) found that organizations which consciously and explicitly create and invest in these aspects of innovation capabilities have a higher probability of achieving sustainable outcomes in their business performance. The new technology introduced adds value and provides solutions to increase competitiveness. In other words, the performance hurdles for success have increased considerably, and high-performing innovators who are able to harness this service innovation capability see significant results.

Service innovation capability has positively affected firm performance (Hult et al., 2004; Panayides, 2006; Salunke et al., 2013). For example, service innovation that encourages collaboration between customers and frontline employees increases sales performance (Melton and Hartline, 2010) and cost performance (Blazevic and Lievens, 2004). In addition, innovation in services may assist companies by bringing a new lease of life to older services r products (Grawe et al., 2009), potentially through creating a new service related to a firm's existing products. Service innovation adds value and allows a firm to reach new potential customers and access new markets (Persson, 1991). Product innovation has been the focus of previous research in this area, while empirical studies have largely ignored service innovation (Grawe et al., 2009). To help reduce this gap, this paper argues that the wide agreement on the existence of a positive relationship between business performance and capacity for innovation presents a strong basis for the postulated connection between sustainable business performance and service innovation capability. In other words, this study posits that:

H3. There is a positive and significant relationship between service innovation capability and sustainable business performance.

2.5. The mediating effect of service innovation capability

Innovation in services is a value-creating activity that leads to growth in business performance (Slater and Narver, 1995). Previous scholars have asserted that service firms can adopt innovation to improve market performance and efficiency as well as to bring benefits to both end-consumers and producers (Bakos, 1998; Garicano and Kaplan, 2001; Hackbarth and Kettinger, 2000). Firm performance and efficiency can lead to improvements in activities such as cost savings, productivity, process improvements, inventory management, quality of production and delivery, value creation and flexibility, price and service. Previous literature has revealed that service innovation capability has a positive link with improving firm performance (Hult et al., 2004; Panayides, 2006; Salunke et al., 2013). In addition, Lawson and Samson (2001) state that companies developing and investing in these aspects of innovation capability have a higher probability of achieving sustainable outcomes in their business performance.

Innovation functions as one driver of business advantage, providing a mixture of resources and capabilities that allows for the development of more sophisticated competencies (Bakar and Ahmad, 2010). Organizational capabilities refer to the physical facilities of a firm and its capacity to apply the assets, skills and expertise of employees, whether tangible or intangible, to activities to improve business performance (Teece et al., 1997; Amit and Schoemaker, 1993). Thus, the term 'capabilities' may also relate to the ability of a firm to amass, combine, and apply the available resources (Bharadwaj, 2000). Finally, capability can also mean the faculty of establishing environmentally innovative technologies and skills throughout the variety of branches of a firm.

Moreover, resources can be broken down into two fundamental categories: tangible and intangible (Galbreath, 2005). Tangible resources are those that have a physical existence, appear on a firm's balance sheet and are more easily understood. Intangible resources are non-physical in nature and include intellectual property, knowledge, skills, and goodwill. According to the resource-based view, intangible

resources are important factors for predicting a firm's success (Amit and Schoemaker, 1993; Barney, 1991). Barney (1991) shifted attention from tangible to intangible resources, asserting that intangible resources might be more important from a strategic point of view because they add value to a firm and make imitation by competitors more difficult. Over time, intangible resources may support a higher level and breadth of activity than tangible resources.

Innovation capability has played an increasingly important role as a mediating variable in management studies (Zhang and Wu, 2013). Innovation capability sometimes refers to service innovation capabilities, which derive from knowledge management and resource utilization. However, only a few studies on technological innovation have conceptualized innovation capability as a mediating model, and service innovation capabilities that examine eco-innovation and sustainable business performance have limited existing research to which to refer. Additionally, as Pöppelbuß et al. (2011) have noted, the effects on sustainable business performance of using service innovation capabilities in support of advanced technologies remain ambiguous.

To address this ambiguity, the most pivotal hypothesis of this paper examines the mediating effect of service innovation capabilities on the relationship between eco-innovation and sustainable business performance. Firms that use green technology have implemented eco-innovations and offer solutions as a complement to the products created, which enhances a firm's ability to innovate. The ability to be innovative stimulates sustainable business performance and is difficult to imitate in the market. This mediating effect of service innovation capability is grounded in the resource-based view as a competitive strategy. Service innovation capability should extend the resource-based view, as knowledge makes a firm more competitive. This study therefore proposes that:

H4. Service innovation capability performs a mediating role in the relationship between eco-innovation and sustainable business performance.

3. Methodology

For this research, data was collected through a quantitative survey. The survey method was selected in order to be able to make statistical inferences and generalize managerial practices among green technology companies regarding eco-innovation, service innovation capability and sustainable business performance. Several steps were necessary in implementing the survey. The first step, which included the conceptual framework, was developed based on previous literature and the perspectives of the resource-based view and the knowledge-based view. The measurement constructs were adapted from validated scales of previous studies. Subsequently, to ensure that data was collected at one specific point in time, the survey was conducted using both postal and online surveys. No response bias was found to exist between these methods of data collection. The VB-SEM measurement model using SmartPLS surpassed reliability, validity, and discriminant validity metrics for the model constructs. Indeed, no evidence existed to signal the existence of common method variance in this model. The results of our hypothesis testing aimed to achieve the aforementioned research objective. Details regarding the procedures used to test the research framework follow.

3.1. Sampling and data collection

Data was collected for use in this research through both postal and online questionnaires. The respondents for this paper were identified through the use of two Malaysian business directories: the MyHijau Directory (2013) and the External Trade Development Corporation (MATRADE) Directory (2014). To boost the response rate, all relevant firms listed in both directories were included (N = 450). Companies involved in consultation in the areas of environment-related products and services, green building, green manufacturing and renewable energy were also encompassed within the sample. This was decided since such companies are involved in eco-innovation through the provision of consultancy services which deal with the use of green technology and the development of green services and products. Prior to the questionnaire distribution, potential firms were contacted to gain their approval to take part and to verify their status. Some redundancy existed in the sample because some firms were listed in both directories. As a result, 221 manufacturing firms using green technology were ultimately identified as utilizing green technology practices and eco-innovation in Malaysia. Different types of managers and businesses using green technology were invited to participate in this survey, which used a stratified random sample (Sekaran and Bougie, 2013).

The unit of analysis in this study was the firm. One survey was distributed to each firm and was addressed to senior managers, such as the Chief Executive Officer (CEO), general manager, or R&D manager, among others. Gentle email and telephone reminders were conducted to improve the response rate. Of the 221 questionnaires distributed, 97 were returned after one month. Of these returned questionnaires, 95 responses were deemed to be fully complete. This quantity of usable questionnaires is comparable with similar survey-based studies in the field of operations management (Jabbour et al., 2016). Because data were collected from both postal and online questionnaires, response bias (χ^2 test) was tested for, with no statistical difference ($p > 0.05$) being detected between the data collected by post ($n = 10$) and that collected online ($n = 85$). The Statistical Package for the Social Sciences Version 20.0 software was used in the data analysis. The data generated included descriptive analysis, non-response bias, and common method variance (CMV). The construct reliability, validity and hypothesis testing used Partial Least Squares - Structural Equation Model (PLS-SEM) 3.0. This statistical software was well suited to predicting the relationships between variables and capable of estimating a complex model. This software does not demand a large sample size and supports non-normal data (Hair et al., 2014).

3.2. Measurements of the model variables

Five dimensions were used for the independent variable (cross-functional coordination, regulation, market focus, supplier involvement and technology), including a mediating variable (service innovation capability) and three dimensions of the dependent variable – performance (economic, environmental and social).

3.2.1. Environmental innovation

In order to assess environmental innovation practices, indicators used in prior research were applied (Proehl, 1997; Rao and Holt, 2005; Khanna et al., 2009; Pinnock et al., 2006; Demirel and Kesidou, 2011; Olson et al., 2011; Pujari, 2006; Vargo, 2009; Fernando et al., 2016). The survey items were designed to elicit the respondents' agreement or disagreement according to a 5-point Likert scale with a number of assertions concerning the five major drivers (from strongly disagree = 1 to strongly agree = 5). Regulation was assessed using four items: compliance with regulation, penalties imposed, inspection and attainment. Four items were also used to measure technology: use of up-to-date green technology, implementation of potential technology, the effectiveness of green technology and the presence of an internal research and development unit. Coordination of cross-functional teams was measured using five items: the effectiveness of communication between departments, the time taken in decision-making, the obligations on members, team members' awareness of collaboration and the support provided by the team chairperson. Four items were used in measuring suppliers' involvement: sharing of information, assessment, collaboration and raising awareness. Finally four items were again used to measure market focus: target market, active engagement, market assessment and obtaining customers' views.

3.2.2. Service innovation capability

Following the method used by Daugherty et al. (2011) and Chapman et al. (2003), six items were used to capture the service innovation capabilities of firms in the sample. All items were measured on a 5-point Likert-type scale (from strongly disagree = 1 to strongly agree = 5). Respondents were asked to indicate their level of agreement with each indicator, such as whether senior management place particular weight on innovation, or effective knowledge management in developing new ideas.

3.2.3. Sustainable business performance

The dependent variable – sustainable business performance – was measured in terms of environmental, economic and social performance. The questionnaire items used for this measurement were based on those used in Zeller et al. (2003), Rao and Holt (2005), Huppes et al. (2008), Castellani and Sala (2010). The respondents rated economic performance in their firms according to indicators including sales volume, profit margin, and market share in the last two years. Environmental performance was measured using four items: waste reduction, environmental improvement, greenhouse gas emissions levels and level of recycling. Similarly, social performance was measured using four items: increase in employment rate, quality of life, community relations and transparency of information provided by the firm.

Table 1 (above) presents a summary of the results of non-response bias testing for the key constructs. Based on an independent-sample t-test, no significant disparities were identified between online and postal surveys. Thus, the analysis shows that non-response bias was not an issue. Ninety-five surveys were analyzed, and respondents were classified according to the firm's profile. To test the difference levels in the profile categories, non-response bias indicators (namely p-value and chi-square) were used.

Table 1 also demonstrates that the profile of respondents was not affected by non-response bias. In this test, respondents who responded later in the survey period were used as a proxy for non-responders. The most common reasons given for potential respondents' failure to complete the survey were time pressures, unavailability of the relevant employee, or the company's perception that there would be no benefit to participating in such a study. Among those who did respond, 22% were employed as managing director, and 21.1% as R&D director. Of the remaining respondents, 18.9% were from other positions, such as assistant to the CEO or technical director/advisor, 9.5% were the CEO themselves, 1.1% were the head/chief/principal, and 6.3% were senior engineers. The largest group of respondents had below five years experience using green technology (49.5%); 29.5% had between 5–10 years (29.5%), 5.3.% had 11–15 years, and 15.8% had 15 years' experience and above.

Table 1
Non-response bias results in terms of main constructs.

	Survey	Mean	Std. Deviation	Std. Error Mean	p-value
REG	Postage	3.6333	.24595	.07778	> 0.05
	Online	3.8627	.81697	.08861	
TEC	Postage	3.8000	.57090	.18053	> 0.05
	Online	3.9843	.70506	.07647	
CROS	Postage	4.1000	.44410	.14044	> 0.05
	Online	3.8794	.63223	.06858	
SUP	Postage	4.0333	.59732	.18889	> 0.05
	Online	3.9647	.63626	.06901	
MAR	Postage	4.0000	.49690	.15713	> 0.05
	Online	4.0078	.61930	.06717	
SERV	Postage	4.1250	.39528	.12500	> 0.05
	Online	3.9500	.68007	.07376	
ECO	Postage	3.6600	.58157	.18391	> 0.05
	Online	3.5576	.65835	.07141	
ENVI	Postage	3.4667	.23307	.07370	> 0.05
	Online	3.8000	.69045	.07489	
SOC	Postage	4.2667	.43885	.13878	> 0.05
	Online	3.6275	.65951	.07153	

Note: REG = regulation, TEC = technology, CROS = cross-functional coordination, SUP = supplier involvement, MAR = market focus, SERV = service innovation capability, ECO = economic performance, ENVI = environmental performance, SOC = social performance.

Table 2 (below) shows the profile of the companies involved. The most popular practice with these firms was renewable energy, used by 24.2% of firms, after which came energy efficiency (20%). Among the other commonly-cited practices were materials and resources (11.6%), consultancy services in green technology (10.5%), indoor environmental quality (8.4%), water management (7.4%), biomass energy (6.3%), sustainable site planning and management (5.3%), other subsectors (4.2%), and water efficiency and innovation (2.1%). Slightly less than half (42.1%) of the firms had been operational for more than 15 years, while 27.4% had been operational for 1–5 years, 14.7% between 11–15 years, and 11.6% between 6–10 years. The firms were mostly fully Malaysian-owned (60%), while 35.8% were local and foreign joint ventures (35.8%), 1.1% were owned by an American company, and 3.2% had other ownership. Selangor, Kuala Lumpur, Penang and Johor, which are technology hubs in Malaysia, contributed the majority of respondents to this study with 56.8%, 24.2%, 9.5% and 5.3% respectively. The remaining states of Pahang, Negeri Sembilan, and Sarawak comprised 4.2% of the respondents in total.

Four categories described the industries of the firms involved in this survey. About 37.9% of organizations were classified as operating in production, 28.4% in infrastructure, 18.9% in ideas and 14.7% in consumption. The findings indicated that process innovation was the most common type of eco-innovation practiced by responding firms (41.1%); second was service innovation (40%), third was product innovation (37.9%), fourth was organizational/management/business model innovation (27.4%), and fifth was innovation through applying a new technology (22.1%).

3.3. Assessment of common method variance (CMV)

Because all measures were collected from the same source, Harman's one-factor test was used here to assess whether common-method variance (CMV) posed a problem for this research (Podsakoff et al., 2003). A significant level of CMV indicates that the first factor can be used to account for greater than half of the total variance observed (Podsakoff et al., 2003; Simonin, 1999). It was found that the first factor in this study was responsible for 28.6% of the overall variance, and that there were 17 factors with eigenvalues above 1.0. CMV was therefore assessed as being unlikely to pose problems for these results, as there was not one overly dominant factor accounting for the majority of the observed variance (Podsakoff and Organ, 1986).

3.4. Reliability and validity

Several tests were used to measure validity in this research. First, this study estimated the reliability of internal consistency using composite reliability (CR). According to Hair et al. (2013), a value of 0.70 or above is adequate for reliability coefficient. Table 3 (below) shows that the CR values for all constructs were higher than the benchmark of 0.70. Second, convergent validity is acceptable when the average variance extracted (AVE) exceeds 0.50 (Fornell and Larcker, 1981). From Table 2 it can be observed the AVE values all surpass this threshold value. Finally, the study also estimated discriminant validity. Where the AVE of each construct exceeds the squared correlation between pairs of constructs, discriminant validity is demonstrated between the latent factors (Fornell and Larcker, 1981). Table 3 indicates that the square root of AVE for all latent variables exceeded the square of the correlations between all variables. The theoretical model was therefore considered to have met the reliability and validity criteria.

Table 2
Firms Profile.

Demographic	Categories	Overall		Postal	Online	Chi-square (χ^2)
		Frequency	Percent	Responses (frequency)	Response (frequency)	Value (p-value)
Type	Energy Efficiency	19	20.0	2	17	.103 ($p > 0.05$)
	Renewable Energy	23	24.2	2	21	
	Biomass Energy	6	6.3	1	5	
	Indoor Environmental Quality	8	8.4	0	8	
	Sustainable Site Planning and Management	5	5.3	0	5	
	Materials and Resources	11	11.6	1	10	
	Water Management	7	7.4	3	4	
	Water Efficiency and Innovation	2	2.1	1	1	
	Consultancy Services in Green Technology	10	10.5	0	10	
	Other	4	4.2	0	4	
Established	< 1 year	4	4.2	0	4	.297 ($p > 0.05$)
	1-5 years	26	27.4	1	25	
	6-10 years	11	11.6	0	11	
	11-15 years	14	14.7	0	14	
	16 years and above	40	42.1	9	31	
Ownership	Malaysian fully owned	57	60.0	9	48	.238 ($p > 0.05$)
	Local and foreign joint venture	34	35.8	1	33	
	Owned to American company	1	1.1	0	1	
	Other ownership	3	3.2	0	3	
Category	Ideas	18	18.9	0	18	.113 ($p > 0.05$)
	Production	36	37.9	1	35	
	Infrastructures	27	28.4	5	22	
	Consumption	14	14.7	4	10	
Type of innovation	Product innovation	36	37.9	0	36	.090 ($p > 0.05$)
	Process innovation	39	41.1	3	36	.453
	Service innovation	38	40.0	3	35	.495
	Organizational/ management/ business model innovation	26	27.4	4	22	.344
	Any innovation applying a new technology	21	22.1	0	21	.075

4. Significant findings and results

The results of the hypothesis testing in this paper are shown in Table 5 (below). This study used 5% p-value or t-value of more than 1.645 (1-tailed) as a cut-off for acceptance. The results show that eco-innovation is significantly and positively related to service innovation capability, meaning that H1 is partially accepted, with a t-value > 1.645. Therefore, dimensions of eco-innovation such as regulation, supplier involvement and technology were positively related with service innovation capability. Another two dimensions of eco-innovation, cross-functional teams and technology, are insignificant, with t-values < 1.645. When the second hypothesis was tested, eco-innovation was shown to have a positive correlation with sustainable business performance, meaning that H2 is also partially accepted with a t-value > 1.645. Hence, the link between regulations and environmental performance was shown to be positive and significant. Positive links between technology and economic performance, cross-functional coordination and social performance, market focus and economic performance, and market focus and social performance supported the hypotheses in this paper. In addition, this study found that service innovation capability had a positive effect on sustainable business performance. Overall, H3 is partially accepted, with a t-value > 1.645. Service capability is significantly and positively related with environmental and social performance. Finally, the effect of service innovation capability on economic performance is insignificant, with a t-value of less than 1.645.

To test hypothesis four, which relates to the mediating role played by service innovation capability, the mediating steps were reviewed to make statistical inferences. The existing literature suggests that mediation implications are justified when the path of the predictor variable and the moderator variable, as well as the path of the mediator variable and the criterion variable, are significant (MacKinnon et al., 2002). Baron and Kenny (1986) state that the predictor variable (X) and the criterion variable (Y) must have a significant relationship to allow for the identification of mediation effects. However, this assumption is no longer necessary for constructing a mediation effect. Scholars have postulated that a mediation effect could be recognized in the absence of a significant direct relationship between the predictor variable (X) and criterion variable (Y) (MacKinnon et al., 2002; Shrout and Bolger, 2002). Thus, by using the arguments of MacKinnon et al. (2002) and Shrout and Bolger (2002), this study tests the mediation effect of service innovation capabilities on the relationship between eco-innovation and sustainable business performance.

This study employs Preacher and Hayes, 2008 ideas to determine the amount of mediation. Tables 4and 5 shows the results of the tests for a mediating effect. Despite the fact that a few sub-mediating hypotheses are not found to be significant, the results in general show that service innovation capability does partially mediate the independent and dependent variables. Some relationships are not mediated by eco-innovation and sustainable business performance, including: cross-functional coordination and economic performance; regulation and economic performance; market focus and environmental performance; regulation and environmental performance; supplier involvement and environmental performance; cross-functional coordination and social performance; and regulation and social performance. These paths were not significant ($p > 0.05$; t value < 1.65).

However, service innovation capability was shown to mediate the following relationships: market focus and economic performance; supplier involvement and economic performance; technology and economic performance; cross-functional coordination and environmental

Table 3
Measurement model VB-SEM results from SmartPLS software.

Model Construct	Measurement Items	Loadings	Composite Reliability[b]	*AVE*[b]	Number of items[1]
Cross-Functional	CROS2	0.712	0.889	0.670	4(5)
	CROS3	0.878			
	CROS4	0.949			
	CROS5	0.708			
Economic Performance	ECO1	0.528	0.869	0.581	5(6)
	ECO2	0.601			
	ECO3	0.880			
	ECO4	0.829			
	ECO5	0.896			
Environmental Performance	ENVI1	0.788	0.798	0.580	3(4)
	ENVI2	0.917			
	ENVI3	0.528			
Market Focus	MAR1	0.595	0.806	0.588	3(4)
	MAR2	0.917			
	MAR4	0.755			
Regulation	REG1	0.899	0.870	0.692	3(4)
	REG3	0.737			
	REG4	0.851			
Service Innovation Capability	SERV1	0.601	0.862	0.614	4(6)
	SERV3	0.843			
	SERV4	0.910			
	SERV5	0.745			
Social Performance	SOC1	0.875	0.822	0.608	3(4)
	SOC2	0.764			
	SOC4	0.690			
Supplier Involvement	SUP2	0.788	0.789	0.556	3(4)
	SUP3	0.763			
	SUP4	0.682			
Technology	TEC1	0.913	0.900	0.752	3(4)
	TEC2	0.754			
	TEC4	0.923			

Note: [a] Composite reliability (CR); [b]Average variance extracted (AVE); [1]Final items numbers (initial numbers).

performance; cross-functional coordination and environmental performance; market focus and social performance; supplier involvement and social performance; technology and social performance. These paths were positive and significant ($p < 0.05$; t value > 1.65). Thus, hypothesis four – that service innovation capability has a partial mediating effect on the relationship between eco-innovation and sustainable business performance – is supported (Table 6).

5. Discussion, implications and conclusions

5.1. Discussion

The increasing awareness of sustainability has drawn organizations' attention to value creation and reputation development and maintenance. This paper sheds light on the concepts of eco-innovation, service innovation capability and sustainable business performance in the context of companies that use green technology in Malaysia. By adopting clear and simple assumptions in the development of concepts to assess the relative importance of eco-innovation and it multiple

Table 5
Hypothesis Testing and Path Coefficients (Direct Effects).

Hypothesis	Path	Coefficient	*t* value
H1a	REG → SERVI	0.248	2.246*
H1b	TEC → SERVI	0.020	0.222
H1c	CROS → SERVI	0.020	0.160
H1d	SUP → SERVI	0.242	2.333**
H1e	MAR → SERVI	0.523	5.597**
H2a	REG → ECO	0.108	1.031
H2b	REG → ENVI	0.246	1.986*
H2c	REG → SOC	0.023	0.232
H2d	TEC → ECO	0.392	3.706**
H2e	TEC → ENVI	0.023	0.129
H2f	TEC → SOC	0.595	4.236**
H2g	CROS → ECO	0.120	0.787
H2h	CROS → ENVI	0.134	1.110
H2i	CROS → SOC	0.167	1.390
H2j	SUP → ECO	0.280	2.380**
H2k	SUP → ENVI	0.154	1.449
H2l	SUP → SOC	0.157	1.253
H2m	MAR → ECO	0.655	4.336**
H2n	MAR → ENVI	0.014	0.062
H2o	MAR → SOC	0.343	1.908*
H3a	SERVI → ECO	0.199	1.519
H3b	SERVI → ENVI	0.665	4.384**
H3c	SERVI → SOC	0.460	3.060**

Note: * $p < 0.05$; **$p < 0.01$.

Table 6
Service innovation capability as a mediator between eco-innovation on sustainable business performance (indirect effects).

Path	SE	t-value
CROSS→SERV→ECO	0.038	0.217
MAR→SERV→ECO	0.077	1.738*
REG→SERV→ECO	0.032	1.210
SUP→SERV→ECO	0.040	1.847*
TEC→SERV→ECO	0.053	1.868*
CROSS→SERV→ENVI	0.087	2.265*
MAR→SERV→ENVI	0.141	1.265
REG→SERV→ENVI	0.074	0.699
SUP→SERV→ENVI	0.071	0.997
TEC→SERV→ENVI	0.122	0.822
CROSS→SERV→SOC	0.056	0.072
MAR→SERV→SOC	0.062	2.935**
REG→SERV→SOC	0.048	1.156
SUP→SERV→SOC	0.060	3.304**
TEC→SERV→SOC	0.103	3.721**

Note: *$p < 0.05$; **$p < 0.01$.

Table 4
Model Construct Discriminant Validity.

Model Construct	1	2	3	4	5	6	7	8	9
Cross-Functional	0.819								
Economic Performance	0.088	0.762							
Environmental Performance	0.204	0.552	0.762						
Market Focus	−0.007	0.667	0.522	0.767					
Regulation	0.167	0.405	0.574	0.340	0.832				
Service Innovation Capability	0.164	0.636	0.704	0.699	0.565	0.784			
Social Performance	0.044	0.760	0.515	0.435	0.488	0.597	0.780		
Supplier Involvement	0.409	0.444	0.421	0.351	0.563	0.581	0.320	0.746	
Technology	0.349	0.027	0.136	0.350	−0.039	0.287	−0.282	0.360	0.867

Note: Diagonal (in bold) represent the average variance extracted (AVE) while the other entries represent the squared correlations.

dimensions, this research strengthens both the theory and practice of sustainable business performance and environmental innovation by providing new evidence concerning the connection between sustainable business performance and eco-innovation, as well as the mediating role which service innovation capability plays in terms of green technology. These findings bridge the gap between ideal and actual scenarios by being useful for both business and policy formulation. The empirical findings have proven the link between direct and indirect effects on the dependent variable. The direct effects of eco-innovation (Pujari, 2006; Carrillo-Hermosilla et al., 2010) and service innovation (Panayides, 2006; Salunke et al., 2013) on sustainable business performance are consistent with those of previous studies. Eco-innovation not only economically benefits manufacturing firms, but also helps them to achieve their desired outcomes for social and environmental performance. Eco-innovation enables firms to create additional value for customers by creating services and products drawn from their employees' green knowledge and expertise on eco-efficient manufacturing processes. Previous findings suggest that eco-innovation can help to unlock more-advanced perspectives on sustainable manufacturing (Dubey et al., 2015a,b; Zhu and Sarkis, 2007). This confirms the relevance of green human resources-related aspects in order to promote green initiatives in firms (Renwick et al., 2016).

Conscious efforts to provide environmental solutions can help to satisfy customers' current needs and create demand for new ones. Green technology used in eco-innovation activities improves firms' innovation capabilities to achieve organizational goals. The empirical findings extend the conceptual framework, linking sustainable business performance and environmental innovation for scholars in areas of operational strategy. This study found a mediating effect of service innovation capability which is positive and partially significant in the relationship between certain drivers of environmental innovation and sustainable business performance. Innovation capability has been proven to play a mediating role in escalating the effects of eco-innovation on sustainable business performance, and this finding is consistent with previous studies (Zhang and Wu, 2013). We argue that the indirect effect of innovation capabilities as a mediator for the best possible resource utilization is aligned with eco-innovation practices. Eco-innovation practices create business sustainability grounded upon knowledge based on environmentally conscious manufacturing processes. Green technology that has been guided by eco-innovation concepts in manufacturing firms improves innovation capabilities and differentiates products from those of existing competitors, leading to lower costs for a firm and a timely and flexible response to market turbulence.

This paper provides three main contributions to selected stakeholders, as detailed in the following sub-sections.

5.2. Implications for theory

The first contribution is to those conducting research. Using the two complimentary theories of the resource-based view and the knowledge-based view, the framework that has been developed creates a better understanding of the green technology movement to support servitization. The two theories used in this study not only complement each other in regard to firms' resources based on employees' knowledge and a firm's ability to innovate in green operations, but also enable a company to sustain its business performance over competitors in its industry. The resource-based view and the knowledge-based view can be used to strengthen the theory of the mediating model, with service innovation capability thus serving as an intervening variable to leverage the impact of eco-innovation on sustainable business performance. The theory of the mediating model is needed to explain the complex business practices of manufacturing firms that are currently transforming themselves into service providers as a business solution. This means that knowledge and technology serve as a cornerstone upon which to develop a firm's ability to innovate with respect to green operations and improve sustainability. This finding bridges a gap in the literature, because previous studies have paid less attention to service innovation capability as a mediating model and to the green movement in manufacturing firms. As a result of this study, scholars should gain a better understanding of the current business practices used by manufacturing firms in order to fine tune theory and literature. Nowadays, manufacturing firms offer products and services as part of the business solutions they offer for environmentally-conscious, friendly, and cost saving-oriented end users.

This study extends the existing literature on operational strategy with empirical findings and justifications for the effect of eco-innovation on triple bottom line aspects of business outcomes for sustainability. This study also provides an understanding of the indirect effect of service capabilities for enhancing the level of eco-innovation towards sustainable business performance. This finding provides support for the need for industrial awareness of environmental and social aspects. Green technology utilization has been proven not only to save costs and increase energy efficiency, but also to open new research opportunities, which contributes to the development of green-conscious frameworks in the manufacturing context. The second implication of this study is in providing benefits to practitioners. The research results presented here provide an empirical foundation concerning the mediating role played by service innovation capability in the relationship between sustainable business performance and environmental innovation, which may prove a useful reference for strategic green planning and for academic developments.

In the Malaysian context, this study provides better understanding and may enhance the attractiveness of adopting environmental innovations. However, if sustainability and long-term survival are to be attained, Malaysian companies must become better at competing in the marketplace, through incorporating eco-innovation and service innovation into their businesses models. Many green technology companies currently focus solely on creating products, while neglecting service innovation capabilities. Service is often forgotten as a core business function in manufacturing firms to ensure business success. However, manufacturing firms are increasingly beginning to understand servitization as a core function of the company (Freitag et al., 2012). Companies should provide solutions that represent service innovation capabilities for end-users. The transformation of the business models of Motorola, Ericsson, IBM, and GE towards servitization represents a change from the manufacturing paradigm of product orientation to a solution-based paradigm in which firms offer total solutions to their customers rather than standalone physical products with simple add-on services. Global manufacturing firms are seeking strategies to develop global service innovations based on the firm's ability to offer service innovation. Manufacturing firms need to develop new competencies in order to understand the often intangible and intrinsic value that services deliver for global customers (Parida et al., 2015).

5.3. Implications for managers and end-users

Our research also has implications for managers and end-users. Although the main factors considered herein are both crucial, they may not in fact correspond with each other in terms of the level of tangible gains offered. With respect to eco-innovation, firms may differently prioritize economic, environmental and societal performance, despite the fact that all three share a similar purpose – that of ensuring success in business. Using the findings of this paper, managers of companies using green technology can be assured that service innovation capability will play a mediating role between eco-innovation drivers and sustainable business performance.

Despite the fact that eco-innovation can leverage service innovation capability and business sustainability, successful implementation of eco-innovation is closely related to government regulation (Vazquez-Brust et al., 2014; Song et al., 2018a, b,c) This paper may be viewed as a justification for imposing and implementing higher environmental

standards when developing policies, and for the enforcement of eco-friendly services and products. If decision-makers want companies to make progress in their sustainability practices, they may be required to provide consistent loans or grants for doing to, and to significantly increase investment in development of infrastructure. This is a vital component because the use of current technology to support eco-innovation practices does not directly influence business sustainability. Green technology companies should ensure they acquire the appropriate technology to support business operations. Thus, the government must be proactive in developing an environment of infrastructure and regulations which encourages productive competition in terms of environmental strategy. The government should work closely with financial institutions to provide soft loans to industry, especially to small and medium-sized enterprises.

This paper demonstrates the importance of practicing eco-innovation, which could lead companies to become more involved in green practices and more socially responsible. As part of their contributions to society, the involvement of firms in such practices would lead to environmental improvements, reduce negative effects on the environment, and decrease the emission of greenhouse gases, which would indirectly also promote the health of society at large. In addition, when more new enterprises or existing companies are involved in sustainable business, this involvement creates more job opportunities and results in higher-quality staff. In turn, this will reduce the unemployment rate in Malaysia, decrease poverty and increase the standard of living. Society will reap the benefits of a green environment with the awareness and ability of firms to renew, reuse and properly dispose of end-of-life products. This would help to solve issues related to worldwide environmental challenges such as global warming and resource scarcity.

6. Final remarks

We suggest that innovation and sustainability are relevant concepts to measure the constructs of eco-innovation (Bossle et al., 2016). Thus, the conclusion of this paper is that, if green technology companies continuously improve their resources, especially in terms of knowledge-based technology and innovation, then service innovation capability plays a mediating role in enhancing the transition from eco-innovation to sustainable business performance. Eco-innovation will help build service innovation capabilities, increase sustainable business performance and make entry into the same market by competitors more difficult. These positive results should reduce companies' doubts about the importance of practicing eco-innovation and developing service innovation capability in their companies. The overall findings support the notion that eco-innovation and service innovation capabilities are important variables that can impact sustainable business performance in companies using green technology. Because this paper has developed a concrete and substantial theoretical foundation in eco-innovation, future studies can leverage this research in further investigations concerning the effects of service innovation capability as a mediator in other industries. A significant positive mediation role fulfilled by service innovation capability is demonstrated this study, coming into play in the relationships between sustainable business performance and certain drivers of environmental innovation.

It is essential that companies using environmentally friendly technology find an equilibrium between the need to increase the sustainability of their products and fulfilling consumers' desires and requirements. While both of these factors are crucial, they may not have equal value in terms of the tangible gains offered. In practicing eco-innovation, firms may differ in their prioritization of economic, environmental and social performance, despite the fact that all these factors share the purpose of achieving business success. Through applying the findings provided herein, managers involved in environmentally friendly technology can ensure that service innovation capability plays a mediating role between sustainable business performance and drivers of environmentally friendly innovation. Service innovation capabilities should align with a customer-driven strategy. Based on the design thinking approach, firms should encourage knowledge-based workers to use eco-innovation principles to design and produce quality services and products.

Malaysia's environmental laws should require regular inspections of companies by regulatory bodies. Monitoring and inspection by regulators can be of assistance in confronting broader environmental concerns. This research may provide policy makers with a justification for the implementation of improved environmental standards for products and services. If such policy makers intend for companies to make progress in terms of sustainable practices, they must also provide incentives for companies to do so, and significantly improve the development of infrastructure. Therefore, governments must be increasingly proactive in providing an environment of regulation and infrastructure which encourages and rewards environmentally friendly business strategy.

Besides a commitment to provide alternative energy solutions to customers, companies using green technology also need to design lean operations to meet efficiency and reliability objectives. Companies must continuously and rapidly seek new technologies to gain competitiveness in their respective industrial sectors. Joint venture companies normally have their own R&D departments, which many local businesses may be unable to afford. Nonetheless, local companies should, wherever possible, also invest in internal research and development in order to create new business opportunities and reach new markets.

Effective cross-departmental communication coordination impacts a company's culture. The success of an organization depends not only on internal departmental workflows but also on cross-departmental workflows. Regardless of the type of ownership, trust should be built within the organization. Strong personal commitment from each team member distinguishes high-performance work teams from low-performance work teams. For an organization to be successful in pursuing productivity and quality, high commitment must be established among all team members. Organizations – and especially fully Malaysian-owned companies – could foster commitment by empowering their employees. To attain an effective cross-functional team that respects Malaysian culture, companies require a skilled team leader who works as a team facilitator, not a dominator. A facilitator supports the efforts of cross-functional teams. For this reason, management should provide leaders who encourage trust and support their team members.

Both joint ventures and fully Malaysian-owned companies should involve their suppliers in the production process (Seles et al., 2016). Both types of ownership should share proprietary information with their key suppliers (Dubey et al., 2015a, b; Dubey et al., 2017). Unfortunately, fully Malaysian-owned companies seldom implement evaluations or assessments of their suppliers, as this is not viewed as a necessity. Joint venture companies must implement evaluation and assessment of their suppliers due to the need to provide quality assurance for global customers. In order to integrate green issues during the design process, companies should collaborate with their suppliers.

6.1. Limitations and suggestions for future research

Like all studies, this paper also has certain limitations. First, the lack of clarity in company data and profiles available in the green directory prevent the authors from using a bigger sample. Second, most manufacturing companies in this industry prefer to act as a solution provider for their customers, rather than simply serve as a manufacturing firm. Finally, the adopted research framework (Fig. 1) could have been more sophisticated.

These research limitations can be overcome by future research efforts. We suggest that future research explores the following aspects. First a similar survey could be carried out in other emerging economies, such as China (Song et al., 2018a), Colombia (Vargas et al., 2018), Brazil (Seles et al., 2016) and India (Dubey et al., 2017). We also suggest that future research considers the inclusion of more variables

(Guerin, 2001) into the research framework (. For example, it would be possible to explore the role of human aspects (El-Kassar and Singh, 2018; Graves et al., 2019) or big data (Song et al., 2018c). These variables could be added by taking into account interaction effects that may occur between them.

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