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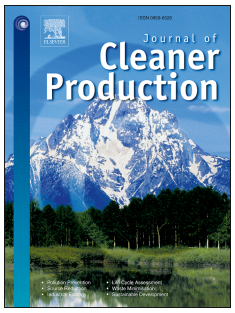

A structural model of the impact of green intellectual capital on sustainable performance

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A Structural Model of the Impact of Green Intellectual Capital on Sustainable Performance

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6988 words

A Structural Model of the Impact of Green Intellectual Capital on Sustainable Performance

Abstract

This study examined the relationship between green intellectual capital and sustainable performance. While many studies have focused on sustainability, this study is one of the first that focuses exclusively on green intellectual capital. This research used survey data from 112 manufacturing firms in Malaysia. As anticipated, the results found that green intellectual capital positively influenced economic, environmental, and social performance. The findings of this study have various implications for green companies and organizations in general and green manufacturing firms in particular. The novelty of this study is unfolding the contribution of green intellectual capital as an intangible resource for organizations in achieving sustainable performance and a competitive advantage for future researchers. Manufacturing industries of developing or developed countries can enhance their cleaner production capabilities by incorporating this model as a strategy.

Keywords

Cleaner production

Economic performance

Environmental performance

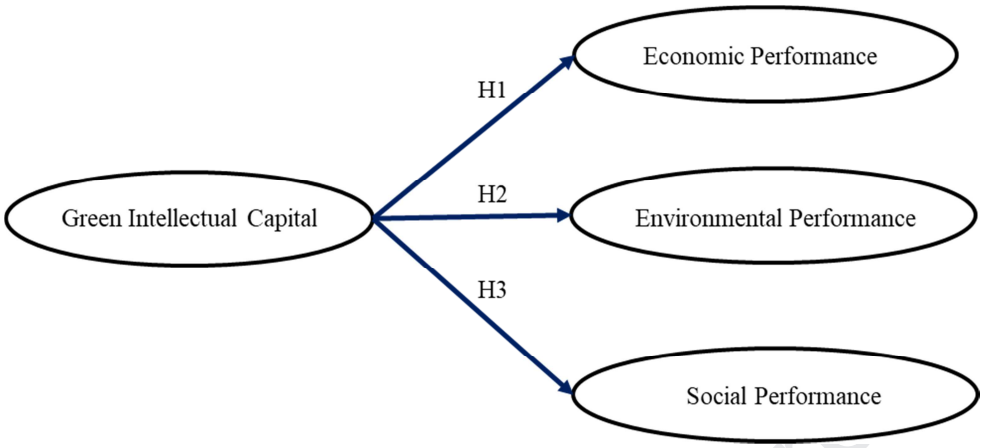
Green intellectual capital

Social performance

Sustainability

6988 words

Graphical Abstract



Research Highlights

- The relationship between green intellectual capital and sustainable performance was explored.
- Intellectual Capital-based View Theory was used as a theoretical foundation.
- Green intellectual capital was found to have a positive relationship with environmental, economic, and social performance.
- Green intellectual capital was highlighted in creating cleaner production and sustainable performance in the manufacturing industry.

1. Introduction

In the past, businesses considered the natural world as a free and limitless good. This attitude led to the "tragedy of the commons," in which individuals and companies believed that their use of the commons had only a negligible effect on the environment. The result of this situation has been pollution and resource depletion (Shaw et al., 2016). With increasing environmental issues being reported, businesses need to adhere to their environmental and natural protection responsibilities. These phenomena have introduced the concept of sustainable performance in which the economic performance of a business is no longer regarded as the only goal to achieve as much emphasis has been placed on achieving social and environmental objectives (Bombiak & Marciniuk-Kluska, 2018).

In line with the cleaner production practices, recent research has shown that sustainable performance has gained heightened attention, and research has begun mainly focusing on the relationship with green human resource management (HRM) (Zaid et al., 2018), green supply chain management (Yildiz Çankaya & Sezen, 2019), and sustainable manufacturing practices (Abdul-Rashid et al., 2017). In addition to this, Severo, de Guimarães, Dorion, and Nodari (2015) asserted that using methodologies for cleaner production organizations can reduce environmental impacts. Apart from these organizational practices, Yusoff et al. (2019) introduced a novel concept; they confirmed that green intellectual capital influenced business sustainability in Malaysian small and medium manufacturing enterprises (SMEs). The study of Yusoff et al. (2019) was aligned with the previous study of Cavicchi and Vagnoni (2017) and affirmed that intellectual capital promotes sustainable development. In addition, practitioners

have also acknowledged the relationship between intellectual capital and sustainability (e.g., Dal Mas, 2019; Massaro et al., 2018).

Undeniably, the impact of the manufacturing industry on the environment is a growing concern, as this industry is being reported as the highest contributor to environmental issues. Many manufacturing firms create waste and pollution and threaten the existence of life on earth (Zailani et al., 2012). From this perspective, promoting sustainable performance is a need to respond to global challenges is of utmost importance in the manufacturing industry. Specifically, Malaysia has reported a 6% growth in CO2 emissions annually (Sadorsky, 2014), which is of concern to academicians and practitioners alike. In this light, the literature on cleaner production practices is not limited to the positive impact in the reduction of environmental degradation; it also helps in the growth of production capacity as well as health and safety aspects. Therefore, sustainable performance requires redesigning business models, the development and organization of new capabilities, and innovation (Cavicchi et al., 2017; Comin et al., 2019). Given the recognized role of intellectual capital in contributing sustainable performance, insights on the role of green intellectual capital remained limited and often ignored by academicians (Yong et al., 2019). Although studies on green intellectual capital have concluded that green intellectual capital has a positive effect on organizational performance (Chen, 2008; Delgado-Verde et al., 2014; Yong et al., 2019), few previous studies have tested the relationship between green intellectual capital and sustainable performance.

In this context, this current work offers an original perspective on the relationship between green intellectual capital and sustainable performance. Its relevance can be justified as follows:

- No study, to the best of our knowledge, has so far explored the relationships herein considered;

- The existing empirical studies has examined green intellectual capital in relation with green HRM (Yong et al., 2019), business sustainability (Yusoff et al., 2019), corporate social responsibility (Chang & Chen, 2012), environmental consciousness and corporate environmental ethics (Chen & Chang, 2013), competitive advantage (Chen, 2008), and environmental product innovation and green social capital (Delgado-Verde et al., 2014).
- No study has provided empirical evidence from Malaysia on the theoretical framework herein presented. The sample of large manufacturing firms used in this study can contribute to overcoming the lack of studies on sustainability (Gunasekaran & Spalanzani, 2012).

Therefore, this study aims to analyze to what extent green intellectual capital may help to improve sustainable performance in large manufacturing firms in Malaysia. A survey was conducted among 112 large manufacturing firms (i.e., employing more than 200 employees) operating in Malaysia. To achieve this research objective, the specific research question to be answered is:

RQ1. Does green intellectual capital predict sustainable performance (environmental, economics, and social performance)?

2. Literature Review

2.1 Sustainable Performance

Since the Brundtland Report (1987) fist considered the concept of sustainability, the issue of sustainability has gained the increased attention of scholars (WCED, 1987). The concerns of the community about environmental issues and rapid changes of external environmental forces have forced all the stakeholders to consider restructuring to meet the challenges (Higgins & Coffey, 2016). The definition that is most widely accepted for sustainability is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43).

Labuschagne, Brent, and Van Erck (2005) and Goyal, Rahman and Kazmi (2013) considered business sustainability from the perspective of the concept of the triple bottom line of Elkington (1998). This definition considered sustainability from the perspective of "adopting business strategies and activities that meet the needs of the enterprise and its stakeholders today while protecting, sustaining and enhancing the human and natural resources that will be needed in the future" (p. 362). The most accepted perspective of sustainable performance has been that of Elkington (1994), who considered the natural environment, society and economic performance, which also aligns with the triple bottom line concept. Economic performance is all about financial performance, while environmental performance is about a reduction in environmental damages and protection from resource exploitation. The last social performance is all about the well-being of employees, customers, and stakeholders.

Similarly, Yong et al. (2019) stated that, in emerging economies like Malaysia, green issues have become noteworthy because of the consumption of more energy and natural resources. For example, CO_2 emissions from the People's Republic of China have been reported to be 7.42%. Past studies have evidenced the significance of the integration of sustainability in various business aspects, e.g., supply chain management (Danese, Lion, & Vinelli, 2019; Mathivathanan, Kannan & Haq, 2018; Taylor & Vachon, 2018; Vachon & Klassen, 2008), product development (Buchert & Stark, 2019; Gould, Bratt, Mesquita, & Broman, 2019; Kalish, Burek, Costello, Schwartz, & Taylor, 2018; Paulson & Sundin, 2019), innovation (Inigo & Albareda, 2019; Neutzling, Land, Seuring, & do Nascimento, 2018; Pedersen, Gwozdz, & Hvass, 2018), integrated management systems (Magon, Thomé, Ferrer, & Scavarda, 2018), operations management (de Burgos Jimenez & Céspedes Lorente, 2001; Magon et al., 2018), information technology (Yusliza, Othman. & Jabbour, 2017) and project management (Martens & Carvalho, 2017; Mavi & Standing, 2018).

These studies affirmed that integration between sustainability and business processes is essential for effective results. These results were discussed in the shape of the efficient and effective use of resources in organizational products and processes. Organizations were found to have positive outcomes, such as a reduction in environmental pollution and waste. These studies also highlighted that the organizational strategies were restructured in light of the efficient use of energy consumption so that the carbon footprints could be reduced. However, major challenges have forced organizations to rethink and redesign strategies for sustainability (Comin et al., 2019; Tseng, Chiu & Liang, 2018; Yusliza et al., 2019).

In addition to this, Yusliza et al. (2019) highlighted the role of the organization and the importance for the organization to behave socially responsible rather than to be environmentally

responsible for meeting their economic objectives. Moreover, organizations must exploit their human resources in pursuing green objectives, which can be linked to sustainable performance. Past studies also highlighted that few studies have been found which focused at micro-level drivers of sustainability e.g., (Akhtar et al., 2018; Fassin et al., 2015; Kim, Kim, Han, Jackson & Ployhart, 2017; Morgeson, Aguinis, Waldman & Siegel, 2013). They have highlighted that the micro-level foundations have been conceptualized as cognitive beliefs and psychological foundations towards social as well as environmental sustainability. Similarly, based on recommendations of previous studies, Dočekalová and Kocmanova (2016) also emphasized that the assessment of corporate performance should include non-financial indicators instead of remaining limited to economic indicators. They also highlighted that corporate performance should also consider intangible assets, e.g., relationships with customers, employees, and other stakeholders.

2.2 Green intellectual capital

The Brundtland Report (1987) forced business organizations in a competitive global economy to behave responsibly towards green practices to become competitive and green (Yong et al., 2019). Moreover, Chang and Chen (2012) asserted that an intense growth had been experienced in global environmentalism in the past decade, and, for the development of green intellectual capital, increasing environmental consciousness is essential. López-Gamero, Zaragoza-Sáez, Claver-Cortés, and Molina-Azorín (2010) argued that the concept of sustainability aims at the future performance of firms rather than current performance and an urge exists to fathom the challenges of sustainability through knowledge. Further, knowledge can

be exploited and gathered in a firm through different approaches to obtain a competitive advantage through intellectual capital. Green intellectual capital is the integration of intellectual capital and environmental concerns at the organizational level or individual level having all types of assets, which are considered intangible, like competencies, knowledge, and interactions (Chen, 2008).

López-Gamero et al. (2011) defined green intellectual capital as "the sum of all knowledge that an organization is able to leverage in the process of conducting environmental management to gain competitive advantage" (p. 21). Generally, intellectual capital is recognized as a multifaceted notion that corroborates it as a non-monetary and non-physical resource of organizations based on practical capabilities, experience, and knowledge to build the value of the organization (Allameh, 2018; Sydler, Haefliger & Pruksa, 2014). Knowledge exists inside the organization in various forms, such as enterprise databases, individuals, external or internal relationships, business process and systems (Yong et al., 2019). Three concepts main measure green intellectual capital: human, relational, and structural.

2.2.1 Green human capital

The Resource-based View Theory highlighted the importance of human capital towards the performance of the organization for gaining a competitive advantage among the competitors (Barney, 2001). Chen (2008) noted the distinct value of green human capital using the assets of employees in terms of knowledge, experience, capabilities, skills, creativities, and commitments altogether towards environmental protection (p. 277). Organizations investing in human capital also gain better performance (Wang, Chang, Huang, & Wang, 2011). Similarly, it is a belief that

greater green human capital tends to contribute more to the development of green organization because of environmental knowledge and skills are rooted in them (Yong et al., 2019). Through the lens of Resource-based View Theory, to gain a competitive advantage, the resources must be rare, valuable, and non-substitutable among the competitors so that they can exploit opportunities (Barney 1991).

Human capital is solely related to the employees and rooted inside them, so when they leave that capital may also withdraw from the organization (Chang & Chen, 2012). Human capital is considered as the most significant intangible asset and results in higher employee satisfaction as well as higher company performance (Allameh, 2018). However, the literature on green human capital is limited (Yong et al., 2019). One belief is that training programs would develop green abilities and increase skills as well because employees are involved in the operations positional. Hence, green human capital enables an organization to recognize its intangible assets (knowledge, skills, and capabilities) and can help to implement green strategies in a dynamic competitive environment to perform better. Translating the goals of an organization to all levels and its realization is dependent on the top management commitment (Williams, Morrell, & Mullane, 2014), and top management commitment role in the adoption of green initiatives is significant (Yusliza et al., 2019).

2.2.2 Green structural capital

In the literature, structural capital is known as the knowledge that comprises non-human assets of an organization. For example, intangible assets include organizational charts, databases, technology aspects, process instruction, and strategies as intangible assets (Jardon & Martos,

2012). Chen (2008) defined green structural capital as the "organizational assets which shows concerns about environmental protection or green innovation inside the company and those assets named as strategies regarding organizational commitments, organizational capabilities, reward systems organizational culture, databases, knowledge management system, information technology, company images, copyrights and trademarks" (p. 227).

Jardon and Dasilva (2017) suggested that environmental concerns are not changed by human capital alone as the support of organizational culture and organizational systems are required for strategic decisions. Structural capital helps an organization in organizing its processes and systems, which further enables the required technological knowledge and become organizational capabilities. Moreover, organizational capabilities become a predecessor in achieving higher sustainable performance (Jardon & Martos, 2012). Yong et al. (2019) highlighted the significant association between organizational culture and green HRM because of organizational environmental culture, which is based on a set of assumptions and symbols.

Also, informational technology plays a significant role in developing green structural capital. Indeed, past studies have verified that EHRM influences green practices (Yusliza et al., 2017; Yusoff, Ramayah & Othman, 2015) and the adoption intensity of IT practices (Ainin, Naqshbandi & Dezdar, 2016) and of green information systems for supply chain activities (Gimenez, Sierra, Rodon & Rodriguez, 2015). Similarly, Chen (2008) and Chang (2011) asserted that green innovation is an essential strategic predecessor to achieve sustainable performance. Lee and Min (2015) highlighted that an organization investing in research and development (R&D) activities, along with eco-innovation, tends to reduce its costs and environmental impacts.

2.2.3 Green relational capital

The literature has contributed to the concept of relational capital. Chen (2008) gave a new name to green relational capital, which he defined as "intangible assets of the company that are based on the relationship between organization and supplier, customers, green innovation, network members, and partners about corporate environmental management with the aim to obtain competitive advantages" (p. 278). Additionally, Stakeholder Theory also acknowledged the significance of the relationship with stakeholders in managing their expectations in the long run for the maximization of a firm's wealth (Donaldson & Preston, 1995). Moreover, the relationship with key stakeholders also plays a significant role in developing sustainable wealth, and this relationship is also a critical one for a particular issue or at a particular time (Post, Preston & Sachs, 2002, p. 8).

Longoni and Cagliano (2018) asserted that stakeholders answers could be addressed through green supply chain management, and other studies also affirmed that relationship between supply chains and environmentalist perspective was a significant tool (Jabbour, de Sousa Jabbour, & Sarkis, 2018; Luthra, Garg, & Haleem, 2016; Zhu, Sarkis, & Lai, 2013). Hence, the strength of the relationship between suppliers and organizations plays a significant role in green relational capital for competitive advantage.

A second important relationship is that with customers, which has arisen in recent years. The expectations of customers have begun to be focused on sustainable environmental behaviors rather than being limited only to product, price or service (Dangelico & Pujari, 2010; Eweje, 2014). Tonial, Cassol, Selig, and Giugliani (2019) stated that in relational capital, the most important component relationship to be considered is the customer relationship because of the

competitive environment, which has changed the focus of organizations from product-oriented to customer-oriented. In this regard, organizations need to maintain their relationship with their customers to have a competitive advantage. Lastly, relationship capital is the concept of the relationship between an organization and its stakeholders. Therefore, the exchange of knowledge is a necessary tool between them is needed to develop partnerships based on a long-term relationship (Tonial et al., 2019).

3. Hypotheses development and theoretical justification

An organization cannot ignore increased environmental concerns (Yong et al., 2019), although they are having sustainable and environmental objectives at high priority, the emerging concept of upstream and downstream partners can be helpful for organizations (McKinsey, 2008). Therefore, studying green intellectual capital because of sustainable objectives is important. Although the increasing scholarship on business has highlighted the importance of sustainability and business firms' beliefs, a need exists to integrate the sustainability dimension, i.e., economic, environmental, and social (Banerjee, 2011). In addition to this, past studies have also provided evidence about the importance of micro-foundations in strategic management, for example, strategic implementation, the contributions of human resources to routines, capabilities, and value execution (Akhtar et al., 2018; Felin, Foss, Heimeriks & Madsen, 2012; Schoenherr, Narasimhan & Bandyopadhyay, 2015). Eisenstat (1996) stated that the effective practicing of human capital could improve the triple bottom line performance of companies, whereas Rayner and Morgan (2018) found a positive relationship between environmental knowledge and employee green behaviors. Top management commitment towards sustainability (Banerjee, Iyer & Kashyap, 2003) and top management commitment in general also influence the behaviors of

employees (Jabbour & Santos, 2008). Ehnert (2009) has identified the required capabilities that contribute to sustainability, such as individual self-knowledge, awareness of values, system thinking, collaboration, and reflection. Chen and Chang (2013) found that green human capital positively affects green innovation performance.

Bansal (2002) highlighted the importance of company policies and structure in the implementation of economic, environmental, and social sustainability. Prajogo and Mc Dermott (2011) verified that organization culture impacts organizational performance (process innovation, product quality, and product innovation). Huang and Kung (2011) also stated that the organizational structure or structural capital are helpful for firms in reducing environmental violation and expenses. These also help firms in developing new markets, increasing productivity and boosting the corporate image and help to sustain a competitive advantage. In addition to this, Chung, Hsu, Tsai, Huang, and Tsai (2012) found a positive relationship between customer loyalty, customer satisfaction, and business performance of an organization. Moreover, Zhu, Feng, and Choi (2017) found a mediation effect of the relationship with customers and trust between green supply chain management economic performance as well as environmental performance.

Organizations are making investments in sustainability because this investment sends a message to its stakeholders that an organization is devoted to environmental and social goals, and is also positively associated with corporate performance (Golicic & Smith, 2013; Podsakoff & MacKenzie, 1997) and sustainability-oriented management practices (Cavicchi & Vagnoni, 2017; Todericiu & Stăniţ, 2015; Tonial et al., 2018). Additionally, Tonial et al. (2018) justified that intellectual capital management supports sustainability activities. Later, Yong et al. (2019) recommended that each dimension of green intellectual capital could be tested in further studies

in different settings, and sustainable performance and competitive advantage could be tested as well.

Furthermore, the use of the Intellectual Capital-based View Theory, and the differentiation between the Intellectual Capital-based View Theory, Knowledge-based View Theory, and Resource-based View Theory is well established (see Yong et al., 2019). Further, Yong et al., (2019) argued that organizations could gain a competitive advantage from their green intellectual capital and that competitive advantage leads to superior performance (Barney, 2001; Branco & Rodrigues, 2006; Khan, Yang & Waheed, 2019; Surroca, Tribó, & Waddock, 2010). Therefore, this current study intends to fulfill the highlighted gap in the literature by proposing the following hypotheses:

H1: Green intellectual capital is positively associated with economic performance.

H2: Green intellectual capital is positively associated with environmental performance.

H3: Green intellectual capital is positively associated with social performance.

4. Methodology

4.1 Research setting and participants

The data were collected from Malaysian large manufacturing firms, which were defined as organizations having more than 200 employees. Human Resource Directors or Human Resource Managers were utilized in this study as informants as they are actively involved in the HRM. The unit of analysis of the study was the individual firm. In this study, the sampling frame was large

manufacturing firms, the details of which were acquired through the directory of the Federation of Malaysian Manufacturer (FMM) 2015. A total of 661 manufacturing firms that had more than 200 employees were drawn from the directory as a sample. This was done because, as Sekaran and Bougie (2016) indicated, a low response rate was possible. Thus, a census was the sampling technique utilized, and all the 661 firms in Malaysia were contacted through the mail survey for this study.

In terms of sample size determination, the G-power sampling size determinant was used in this survey. The model of this study had four main variables. By using G-power with an effect size of 0.15, alpha of 0.05, and a power of 0.8, the minimum sample size needed was only 85. Because we have 112 large manufacturing firms and having more than 200 employees in an organization, this can already be considered a large sample as the population of large companies in Malaysia is small. Thus, we can conclude that our study with a sample size of 112 has a power of more than 0.9 is large enough and the findings can be used with confidence.

The demographic analysis confirmed that most companies were electronic and electrical industry (25.0%). Whereas the large manufacturing firms had employees between 201 to 500 (42.0%) and, in the HR department, the number of employees was between 5 to 10 (35.7%). Of the firms used in this study, 61.6% were established 20 years ago, and most of them were MNCs (52.7%). The most important information was carried out in this study, which shows that the companies that were taken in this sample are valid. For example, 88.4% of manufacturing firms who participated in this study had ISO 9000 certification who participated in this study, and 71.4% of the firms had ISO 14000 certification.

4.2 Measures

4.2.1 Green intellectual capital

The green intellectual capital scale that Chen (2008) developed was used for this study. Sample items were: "the contribution of environmental protection of employees in our firm is better than our major competitors" (Green human capital); "The management system for environmental protection in our firm is superior to that of our competitors" (Green structural capital); and "Our firm designs products and/or services in compliance with the environmentalism desires of our customers" (Green relational capital). The scale had 18 items, which were assessed on a 5-point Likert scale were answers ranging from 1 ("strongly disagree") to 5 ("strongly agree"). For the computation of green intellectual capital score, the average was utilized for the responses of items.

4.2.2 Sustainable performance

A sustainable performance scale adapted from Zhu, Sarkis, and Lai (2008), Laosirihongthong, Adebanjo, and Tan (2013), and Paulraj (2011) was used for this study. This scale consisted of 15 questions. The respondents were asked to respond on a 7-point Likert scale ranging from 1 ("not at all") to 7 ("to a very great extent").

Table 1 shows the statements utilized for all the selected items in the research questionnaire. As highlighted above, all the selected items were validated by the literature.

Table 1
Constructs/Items used in the research's questionnaire

Construct	Definition	Item	Adapted from
Environmental Performance	The ability of an organization to reduce air emissions, energy consumption, hazardous material, material usage and compliance with environmental standards	ENP1: Improved compliance with environmental standards. ENP2: Reduction in air emissions. ENP3: Reduction in energy consumption. ENP4: Reduction in material usage. ENP5: Reduction in the consumption of hazardous materials.	Laosirihongthong et al. (2013)
Economic Performance	The ability of an organization to reduce costs associated with purchased materials, energy consumption, waste treatment, waste discharge, and fines for environmental accidents	ECP1: Decrease in costs for materials purchasing. ECP2: Decrease in costs for energy consumption. ECP3: Decrease in fees for waste treatment. ECP4: Decrease in fees for waste discharge. ECP5: Decrease in fines for environmental accidents.	Zhu et al. (2008)
Social Performance	The ability of an organization to improve social welfare and betterment, community health and safety, risks to the general public, occupational health and safety of employees	SCP1: Improved overall stakeholder welfare. SCP2: Improvement in community health and safety. SCP3: Reduction in environmental impacts and risks to the general public. SCP4: Improved occupational health and safety of employees. SCP5: Improved awareness and protection of the claims and rights of people in the community served.	Paulraj (2011)
Green Human Capital	The summation of employees' knowledge, skills, capabilities, experience, attitude, wisdom, creativities, and commitments, etc. about environmental protection or green innovation, and was embedded in employees, not in organizations	GHC1: The contribution of the environmental protection of employees in our firm is better than our major competitors. GHC2: Employee competence concerning environmental protection in our firm is better than that of our major competitors. GHC3: The product and/or service qualities of environmental protection provided by the employees of this firm are better than our major competitors. GHC4: The amount of cooperative teamwork concerning environmental protection in our firm is more than that of our major competitors.	Chen (2008)

		GHC5: Our managers fully support our employees in achieving their goals concerning environmental protection.	
Green Structural Capital	The stocks of organizational capabilities, organizational commitments, knowledge management systems, reward systems, information technology systems, databases, managerial mechanisms, operation processes, managerial philosophies, organizational culture, company images, patents, copyrights, and trademarks, etc. about environmental protection or green innovation within a company	GSC1: The management system for environmental protection in our firm is superior to that of our major competitors. GSC2: Our firm is more innovative concerning environmental protection than are our major competitors. GSC3: The profit earned from the environmental protection activities of our firm is greater than that of our major competitors. GSC4: The ratio of investments in R&D expenditures to sales for environmental protection in our firm is more than that of our major competitors. GSC5: The ratio of employees to the total employees in our firm who are engaged in environmental management is more than that of our major competitors. GSC6: Investments in environmental protection facilities in our firm are more than those of our major competitors. GSC7: Competence in developing green products in our firm is better than that of our major competitors. GSC8: The overall operational processes for environmental protection in our firm work smoothly. GSC9: The knowledge management system for environmental management in our firm is favourable for the accumulation of the knowledge of environmental management.	Chen (2008)
Green Relational Capital	The stocks of a company's interactive relationships with customers, suppliers, network members, and partners about corporate environmental	GRC1: Our firm designs products and/or services in compliance with the environmentalism desires of our customers. GRC2: Customer satisfaction concerning the environmental protection of our firm is better than	Chen (2008)

management and green innovation, which enables it to create fortunes and obtain competitive advantages	that of our major competitors. GRC3: The cooperative relationships concerning the environmental protection of our firm with our upstream suppliers are stable. GRC4: The cooperation relationships about the environmental protection of our firm with our downstream clients or channels are stable. GRC5: Our firm has well cooperative relationships concerning environmental protection with our strategic partners.

5. Data analysis and results

Because data were collected from a survey, multivariate normality was tested using the web software, https://webpower.psychstat.org/models/kurtosis/, as Cain et al. (2017) suggested. The Mardia's coefficient of multivariate skewness was 5.346 (t = 99.804, p< 0.01) and kurtosis was 52.478 (t = 2.418, p< 0.05) suggesting that the data was not multivariate normal. Thus, SmartPLS 3.2.8, a second-generation structural equation modeling software, was selected to test the model with the use of bootstrapping. Following the suggestions of Hair et al. (2019) and Ramayah et al. (2018), the measurement model was first tested, which was followed up with the structural model.

As data were gathered from a single source, a full collinearity assessment was run to test whether common method bias was a concern in our study, as Kock and Lynn (2012) suggested to assess the issue of common method bias. First, a dummy variable using the random function in Excel was created; then, all the constructs (including the dependent variable) were regressed in

the research model against this common variable. The results shown in Table 2 indicate that no serious concern was present as the VIFs were all below the threshold of 3.3.

Table 2
Full Collinearity Estimates

Economic Performance	Environmental Performance	Social Performance	Green Intellectual Capital
2.827	2.924	2.432	1.211

Note: The VIFs shown are for all the latent variables; a "dummy" latent variable criterion was used. VIFs equal to or greater than 3.3 suggest collinearity

5.1 Measurement Model

The loadings from the results, along with the average variance extracted and composite reliability were assessed to ensure that the measurement items were valid and reliable. Since the study had a second-order measure for green intellectual capital, all the first-order components were assessed before testing for the second-order measurement validity and reliability. As shown in Table 3, all the loadings were higher than 0.708, AVEs were higher than 0.5, and the CRs were all higher than 0.7 indicating that all the measurements are valid and reliable for first order as well for second-order (Ramayah et al., 2018, Hair et al., 2019).

Afterward, the discriminant validity was tested by using the HTMT criterion that Henseler et al. (2015) suggested. If the ratios were lower than $HTMT_{0.85}$, then the conclusion could be made that all measures were discriminant. Also, Franke and Sarstedt (2019) suggested that if the upper limit of the HTMT bootstrapping value does not contain a 1, then the measures are

discriminant. As shown in Table 4, all the ratios were below a cut-off value of 0.85; as such, the measures are distinct.

Table 3
Measurement Model

First Order	Second Order	Items	Loadings	CR	AVE
Green Structural Capital		GSC1	0.852	0.948	0.672
		GSC2	0.862		
		GSC3	0.822		
		GSC4	0.829		
		GSC5	0.816		
		GSC6	0.842		
		GSC7	0.812		
		GSC8	0.724		
		GSC9	0.809		
Green Human Capital		GHC1	0.727	0.908	0.667
		GHC2	0.872		
		GHC3	0.895		
		GHC4	0.887		
		GHC5	0.677		
Green Relational Capital		GRC1	0.831	0.949	0.787
		GRC2	0.887		
		GRC3	0.890		
		GRC4	0.901		
		GRC5	0.925		
	Green Intellectual Capital	Green Structural Capital	0.976	0.951	0.865
		Green Human Capital	0.893		
		Green Relational Capital	0.920		
Economic Performance		ECP1	0.892	0.942	0.766
		ECP2	0.899		
		ECP3	0.917		
		ECP4	0.919		
		ECP5	0.734		
		ENP1	0.764		
Environmental Performance		ENP2	0.842	0.915	0.683
		ENP3	0.821		

	ENP4	0.886		
	ENP5	0.813		
Social Performance	SCP1	0.854	0.947	0.780
	SCP2	0.935		
	SCP3	0.915		
	SCP4	0.822		
	SCP5	0.886		

Table 4
Discriminant Validity (HTMT Ratios)

	1	2	3	4
1. Economic Performance				
2. Environmental Performance	0.832			
3. Green Intellectual Capital	0.278	0.388		
4. Social Performance	0.687	0.823	0.417	

5.2 Structural Model

Following Hair et al. (2019) suggestions, the path coefficient, t-values, p-values, and the standard errors were reported for the structural model using a 5,000-sample re-sample bootstrapping procedure. Additionally, Hahn and Ang (2017) had argued that p-values are not a good criterion for testing the significance of hypothesis and suggested using a combination of criterions such as p-values, confidence intervals, and effect sizes. Table 5 shows a summary of the criterions used to test the hypotheses developed.

Green intellectual capital was positively related to economic performance (R^2 = 0.073, β= 0.234, p= 0.003), environmental performance (R^2 = 0.135, β= 0.234, p< .001) and social performance (R^2 = 0.161, β = 0.234, p< .001). Thus, all three hypotheses, H1, H2 and H3 were supported. Green intellectual capital explained about 7.3% of the variance in economic

performance, 13.5% of the variance in environmental performance and 16.1% of the social performance.

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Table 5
Hypotheses Testing

Hypotheses	**Relationship**	**Std. Beta**	**Std. Error**	**t-value**	**p-value**	**95% BCI LL**	**95% BCI UL**	**f^2**	**Q^2**
H1	GIC → Economic Performance	0.270	0.098	2.756	0.003	0.112	0.411	0.078	0.048
H2	GIC → Environmental Performance	0.367	0.084	4.387	p< .001	0.217	0.493	0.156	0.077
H3	GIC → Social Performance	0.401	0.085	4.730	p< .001	0.238	0.532	0.192	0.116

6. Discussion

Based on the research objectives, the hypotheses of the study, which is green intellectual capital positively correlated to sustainable performance (economic, environmental, and social performance), were statistically supported. These hypotheses are also in line with Marr and Schium (2001) in that intellectual capital is associated with the organization and a positive effect on the competitive advantage as well as performance. The results of this study also prove that, under the umbrella of green intellectual capital, employees who are more concerned and have competency, skills, and knowledge leads to competitive advantage, which tends to increase the economic performance of an organization. These results are also in line with the Intellectual Capital-based View Theory, which explains that knowledge capital has a direct relationship with a competitive advantage and organizational performance (Youndt & Snell, 2004).

The results align with previous studies that have acknowledged that human capital is an important factor, and human abilities make a significant contribution to the rectification of environmental pollution issues and energy consumption (Pablo-Romero & Sánchez-Braza, 2015). These results also align with the Intellectual Capital-based View Theory that explains that knowledge capital has a direct relationship with a competitive advantage and organizational performance (Youndt & Snell, 2004). Therefore, an employee's knowledge, competencies, skills, and attitudes are not applied only to environmental protection but are important characteristics of green intellectual capital, which helps in cleaner production activities. Employees who have greater skills and knowledge of green activities help in improving the efficiencies, such as reduction of waste, cost, and consumption.

The findings of this current study indicate that an employee's contributions and competencies help to reduce carbon emission, which aligns with Bano, Zhao, Ahmad, Wang, and Liu (2018). Therefore, employee's knowledge, competencies, skills, and attitudes on environmental protection are important characteristics of green intellectual capital. These arguments are also in line with the previous study; individual competencies play a significant role in aligning sustainable performance through innovation perspective, e.g., teamwork and collaborative attitude (Jabbour & Santos, 2008).

The results also depict that green intellectual capital is correlated with all the dimensions of sustainable performance (e.g., economic, social, and environmental). The findings of this study also contributed to the existing body of knowledge in response to Kovács's (2008) concerns about examining upstream and downstream client's implications towards environmental and social. Items of green intellectual capital in this study have included the relationship between an organization and upstream or downstream clients. The structural equation model shows that upstream and downstream clients have a positive impact on all the dimensions of sustainable performance. Karaosman, Perry, Brun, and Morales-Alonso (2018) also found that environmental performance is affected by collaboration with upstream clients, and product-based performance is associated with downstream collaboration.

Similarly, Jabbour et al. (2018) also found an association between supply chain tools and environmental perspective as well as competitiveness and economic performance (Khan & Qianli, 2017; Rao & Holt, 2005). Moreover, Gelhard and von Delft (2016) also found that customer integration is positively associated with a sustainable performance by exploiting their input as knowledge on customer needs, which also significantly affect environmental and social demands. This study has also indicated that manufacturing organizations in Malaysia have built a

relationship with the upstream and downstream clients in response to the environmental protection towards sustainable performance in cleaner production activities.

Finally, this study has investigated the relationship between green intellectual capital and sustainable performance in the era of emerging countries, specifically the Malaysian context. Therefore, this study represents the first attempt to test the green intellectual capital on sustainable performance empirically. However, the findings of this study affirmed that green intellectual capital has a greater impact on social performance as compared to the other performance metrics of sustainability. In this study, social performance conceptualized as improvement of stakeholder welfare, community health and safety, employee's health and safety, and reduction of risk on the general public.

6.1 Theoretical and managerial implications

This study offers several significant contributions to researchers and practitioners. This study has contributed to the existing body of knowledge by investigating the association between green intellectual capital and sustainable performance. The originality of this work explained through the Intellectual Capital-based View Theory, which aims to gain a competitive advantage/performance of firms from the intangible resource of an organization (Youndt & Snell, 2004). Contextually, this study also adds contributions. According to the best knowledge of the researchers, this was the first study conducted in the manufacturing industry of Malaysia to measure sustainable performance. As indicated in Yong et al. (2019), Malaysia is consuming more energy and natural resources that has resulted in 6% CO_2 emissions. An employee's contribution to the reduction of the emissions of CO_2 is significant in terms of green skills and

green capital structure (Akhtar et al., 2018; Jabbour, 2013; Yong et al. 2019) and active support of employees (Sweetman, 2007). Secondly, this study has contributed in literature of green human capital by observing the concepts of micro-foundations (Fassin et al., 2015) and psychological foundations (Doh & Quigley, 2014) in understanding of environmental sustainability. The study also shows that an employee's skills, competencies and top management support in the manufacturing organizations of Malaysia have the concerns of environmental protection and committed to gain competitiveness as well as sustainable performance.

Furthermore, this study is the first attempt to extend the literature of organizational behavior literature concerning environmental studies. It extends research on sustainable performance by investigating how green intellectual capital in manufacturing firms leads to sustainable performance. In particular, the identification of these connections expands our understanding of how manufacturing firms should manage their green intellectual capital strategically to achieve sustainable performance.

Moreover, the research offers fruitful managerial implications. This study was conducted in the manufacturing industries of Malaysia, which shows uniqueness in terms of environmental protection and awareness of CO_2 emissions. Secondly, the top management, employees, suppliers, and customers are all well aware of environmental protection and sustainability issues. The study also contributes to the practitioners and is helpful for the managers in terms of the current state of their stakeholder's perception of environmental, social, and economic performance. Apart from these, using this model in manufacturing industries in developing countries is expected to improve the cleaner production capabilities of organizations and the use of green intellectual capital as a strategy to achieve sustainable performance.

Despite all these arguments and all hypotheses supported in this study, the main critical point is the confirmation of the impact of green intellectual capital on sustainable performance. Intangible assets play an essential role in achieving organizational sustainability goals. The results also extend the literature that intangible assets are not merely limited to the economic growth of an organization. That is because green skills, abilities, and capabilities as assets of the manufacturing industry are significant in increasing the community welfare, health, and safety. Also, this study has confirmed that knowledge is an asset that can become a unique source of competitiveness among competitors (Yound et al., 2004) and an important contributor to cleaner production strategies. Organizations gain benefits from an employee's knowledge and skills in boosting economic growth by reducing energy consumption, production waste, and raw material wastage. Moreover, employees also tend to increase environmental performance by reducing air emissions and hazardous material. Therefore, this study confirmed the association between green intellectual capital and sustainable performance.

7. Conclusion

The study has contributed to the existing body of knowledge in achieving a higher level of sustainable performance in the manufacturing firms of Malaysia. The role of green intellectual capital was found to be significant, which helps firms to achieve sustainable performance. Green intellectual capital was found to be a critical dimension in environmental related issues. Not limited only to environmental issues, the study has provided evidence that green intellectual capital is also associated with social performance. Hence, this study provided evidence that green

intellectual capital tends to influence little but has a positive association with economic, environmental and social performance in the large manufacturing firms of Malaysia.

8. Limitations and Future Directions

Although the outcomes have shown strong relationships for achieving sustainable performance, this study has several limitations. First, the study has a limited sample, although it was statistically sufficient. Future studies may consider a larger sample size to produce more generalizability. Second, the study setting was cross-sectional; future studies should include longitudinal settings. Moreover, future studies could test the current model in other industries, countries and make a cross-country comparison to enhance the generalizability of the results. In addition, to extend the literature, future studies are recommended to make advances in the literature of green management and green HRM as recommended in previous studies (see Centobelli, Cerchione, & Eposito, 2017; Jabbour & Renwick, 2018). Future studies may extend this research by investigating the mediating effect of green intellectual capital in between green HRM and sustainable performance. Jain, Vyas, and Roy (2017) found the limited role of mediation of intellectual capital, which requires further testing. Future studies may extend the literature by examining the micro-foundations level, e.g., top management cognitive attitudes, beliefs, knowledge (Smith, Benson, & Curley, 1991), and level of experience in the adoption of green HRM practices and how this leads to sustainable performance. Finally, Renwick et al. (2016) highlighted the intervention approaches, e.g., training to mitigate the green issues as a motivational strategy. Future studies may consider the moderating role green training in between

green intellectual capital and sustainable performance. The assumption is that higher green training will build higher green intellectual capital and sustainable performance.

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