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A RELATIONSHIP ANALYSIS BETWEEN GREEN SUPPLY CHAIN PRACTICES, ENVIRONMENTAL MANAGEMENT ACCOUNTING AND PERFORMANCE

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Abstract: Green supply chain practices and environmental management accounting are gaining popularity as a management approach for positive environmental improvement activities and performance. Many organisations, nevertheless, are not aware of their significance to environmentally sustainable development. This research aims to develop a structural framework to empirically test the relationship between green supply chain practices and environmental management accounting which may affect environmental and economic performance particularly, to understand the key sustainability drivers when making decisions concerning environmental protection and cost saving. A questionnaire survey was employed to collect data from the environmental management representatives who are the target respondents of ISO 14001 certified organisations in Malaysia. The findings revealed a significant relationship between green supply chain practices and environmental management accounting to environmental performance. The economic performance is actualised through the improvement in environmental performance. The economic gain in the form of cost-saving can be leveraged from the collective implementation of green supply chain practices and environmental management accounting through the focus on environmental performance. Operational managers, environmental management representatives and accountants are offered insights into how GSCPs and EMA contribute to the development of better provisions for environmental risk assessments, environmental costing determinations and environmental investment decisions.

Keywords: Green supply chain practices, environmental management accounting, environmental performance, economic performance.

Introduction

Malaysia, as a rapidly developing Asian country, is facing many pressures and doubts in environmental and corporate sustainability issues (Goh & Nabsiah, 2010; Ong *et al.*, 2016). It is a challenge for Malaysian organisations to balance the increase in environmental concerns toward the industrialised economy as Malaysia is pursuing an agenda of rapid modernisation and urbanisation. The Eleventh Malaysia Plan (2016-2020) is breaking free from the conventional wisdom to develop green growth and encourage the 3Rs, that is; Reduce, Reuse and Recycle. Another initiative is the establishment of the Business and Environmental Awareness by the Malaysian International Chamber of Commerce and Industry, together with the Business Council for Sustainable Development. These underscore Malaysian organisations' interest to devise strategies for recycling, reusing, and disposing of used and toxic discharge safely. However, despite government efforts and growing public awareness of environmental issues, environmental problems continue to persist. Open-burning, black smoke emissions, water pollution and industrial effluents are among some of the major environmental offences committed by Malaysian organisations (DOE, 2016).

Various environmental incidents have also made headline news which the waste disposal incidents have led to many arguments stating that organisations must move their businesses in a more environmentally sustainable direction. The pollution problem could be minimised if organisations adopt an environmental management system to dispose of industrial waste properly and safely. In Malaysia, the ISO 14001 certification is the most recognised environmental management approach employed by environmentally conscious organisations to manage its environmental aspects (Eltayeb *et al.*, 2011). Organisations are encouraged to continuously improve their environmental management competency and not do so solely to acquire ISO 14001 certification (Darnall *et al.,* 2008). Green supply chain practices that integrate with the ISO 14001 existing environmental management system are vital to gain environmental collaboration, commitment and competitive advantages to achieve organisational performance outcomes (Rusli *et al.,* 2013; Hassan *et al.,* 2016).

Green supply chain practices (GSCPs) facilitate ISO 14001 certified organisations to achieve lower environmental impacts throughout the entire supply chain (Darnall *et al.,* 2008; Zhu *et al.,* 2012; Hsu *et al.,* 2013). The application of GSCPs includes intra- and inter-organisational environmental practices covering the upstream to downstream (Green *et al.,* 2012; Zhu *et al.,* 2012) by focusing on environmental reduction collaboration and reciprocity (Khairani *et al.,* 2016). The intra- and inter-organisational integration demonstrates the effectiveness of greening the supply chain to gain collaboration, commitment and competitive advantage in environmental protection (Cheng *et al.,* 2008; Abd Rahman *et al.,* 2014). Several GSCPs have been developed to reduce environmental issues, which include the internal environmental management system (IEM), green purchasing (GP), eco design (ECO) and reverse logistics (RL). These GSCPs promote efficiency and synergy between business partners to minimise wastage to enhance environmental performance (Green *et al.,* 2012; Zailani *et al.,* 2012; Zhu *et al.,* 2012). Nevertheless, studies revealed a positive but mild relationship between GSCPs and ENP. Study by Green *et al.,* (2012) recognised a positive relationship but the adoption of green purchasing and green design achieved better environmental performance than other green practices. Tritos *et al.* (2013) and Abd Rahman *et al.* (2014) revealed a positive and mild relationship between GSCPs and ENP. These results recognised the positive relationship yet ambiguous and inconsistent results. Hence, this study argues that the corrective green supply chain practices that include the internal environmental system, green purchasing, eco design and reverse logistics are proposed to effectively improve the environmental performance.

The literature has recognised the importance of environmentally informative techniques that capture data to generate valuable resources to support Malaysian manufacturers (Wooi & Zailani, 2010; Shaharudin *et al.,* 2015; Zailani *et al.,* 2017). According to Ong *et al.* (2016), Environmental Management Accounting (EMA) is a critical mechanism that addresses diverse aspects of environmental management from the ISO 14001 Standards. It is widely accepted as a reliable source of information for its relevance in capturing environmental activities to help organisations identify, control, and improve their environmental and economic performance (Jamil *et al.,* 2015; Mokhtar *et al.,* 2016).

EMA has been introduced as a decision-making tool to support ISO 14001 certified organisations with valuable environmental information in decision-making, planning, monitoring and evaluating to ensure the achievement of strategic environmental objectives (Mokhtar *et al.,* 2016; Ong *et al.,* 2016). According to Jalaludin *et al.* (2010), EMA provides relevant and reliable information to identify key sustainability drivers to facilitate the appropriation of the potential benefits in environmental protection and neutralising environmental threats (Kokubu & Nashioka, 2008; Vasile & Man, 2012; Jamil *et al.,* 2015). However, the adoption of EMA has been perceived as a less significant strategic environmental management approach in Malaysia (Jalaludin *et al.,* 2010). The EMA information to support cost-saving initiatives (Mokhtar *et al.,* 2016) is yet to be fully understood, as it is perceived as internal cost accounting rather than environmental reduction initiatives (Jalaludin *et al.,* 2010). Further, the understanding of the complexity of measuring environmental effects and transmitting environment-related information to improve ENP and ECP is still inconclusive.

Zhu *et al.* (2010) explained ENP measures as the ability of an organisation to reduce waste and its commitment to environmental sustainability. ECP demonstrates the better use of organisational resources to create an advantageous position to bring about benefits in cost savings through the actions of reduction, reuse and recycle (Green *et al.,* 2012; Fraj *et al.,* 2013). The literature acknowledges that economic payback through cost-saving measures is the organisation's ability to simultaneously meet cost, quality, and performance goals while reducing environmental impacts and motivating organisations to implement environmental-related initiatives such as EMA and GSCPs (Jalaludin *et al.,* 2010; Zhu *et al.,* 2010).

The literature has proven the positive relationships between GSCPs-ENP and EMA-ENP (Jalaludin *et al.,* 2010; Zhu *et al.,* 2012; Ong *et al.,* 2016). However, the performance outcome of an organisation's capabilities to minimise emissions, effluents, and wastes that lead to decreases in costs associated with the materials purchased, energy consumption and fines for environmental accidents are yet to be understood. Hence, this study examines the direct and indirect relationship between GSCPs, EMA, ENP and ECP. The aims are to develop a comprehensive framework that combines the GSCPs implementation, EMA information for environmental decision-making and the evaluation of the relationship between ENP and ECP. Notably, the mediator role of ENP is tested empirically. This study argues that applying GSCPs and EMA can maximise ECP by improving ENP. To extend the understanding and analysis of these interactive relationships, the literature on GSCPs, EMA, ENP and ECP is discussed, and hypotheses were developed. The research methodology and findings are discussed and followed by a discussion of the findings and conclusion.

Green Supply Change

Greening the supply chain has emerged as the essential green initiatives that reduce the sources of waste or pollution by using the life-cycle assessment (Eltayeb *et al.,* 2010; Zhu *et al.,* 2012; Abd Rahman *et al.,* 2014). According to Eltayeb *et al.* (2011), GSCPs captured the source of environmental reduction that aims to eliminate, reduce and prevent pollutions associated with suppliers and customers. The literature suggests that implementing GSCPs assists ISO 14001 certified organisations in decreasing air emissions, wastewater, solid wastes and the frequency of environmental accidents (Eltayeb *et al.,* 2011; Zhu *et al.,* 2012; Abd Rahman *et al.,* 2014; Hassan *et al.,* 2014). Numerous GSCPs have been developed to reduce environmental issues, including the internal environmental management system (IEM) which emphasises internal waste management (Zhu *et al.,* 2012), green purchasing (GP) with a focus on suppliers' environmental compliance (Eltayeb *et al.*, 2010; Chin-Chun *et al.*, 2013), eco design (ECO) ensures that environmental risks are captured at the initial design stage (Eltayeb *et al.,* 2010) and reverse logistics (RL) retains the recycled packaging for reuse and closes the supply chain loop (Eltayeb *et al.*, 2010; Chin-Chun *et al.*, 2013). These GSCPs promote efficiency and collaboration between business partners to minimise wastage to enhance environmental and economic performance (Eltayeb *et al.,* 2011; Zailani *et al.,* 2012; Zhu *et al.,* 2012).

A clear performance measurement can help managers move in the right direction and focus on what should be achieved (Zhu *et al.,* 2010; Wu & Lin, 2013). Environmental performance (ENP) pertains to an organisation's ability to reduce air emissions, wastewater, and solid waste, decrease its consumption of hazardous or toxic materials and decrease the frequency of environmental accidents to improve the environmental situation (Zhu *et al.,* 2012). ENP aims to prevent emissions and wastes at the sources (avoidance options) by better utilising raw and auxiliary materials and requiring less (harmful) operating materials (Green *et al.,* 2012). According to Eltayeb *et al.* (2011), the ability to reduce air emissions, wastewater and solid wastes are important indicators to show an organisation's environmental responsibility and commitment.

Economic performance (ECP) concerns the ability to reduce costs associated with the purchase of materials, energy consumption, waste treatment, waste discharge, and fines for environmental accidents (Green *et al.,* 2012; Zhu *et al.,* 2012). Study by Faj *et al.* (2012) explained that ECP is the economic result of the positive influence in reducing pollutants, wastes and environmental protection expenditures. Identifying the potential cost savings from environmental abatement activities helps to shape the environmental measurement practices, provides the foundation for sustainable development and suggests options to improve organisational strategy. The literature acknowledges that ENP and ECP enable decision-makers to have a quick overall view of the progress and problems to achieve the desired environmental targets and goals (Eltayeb *et al.,* 2010; Mokhtar *et al.,* 2016). Implementing GSCPs and EMAs creates favourable outcomes to improve environmental and economic performance (Eltayeb *et al.,* 2010; Zhu *et al.,* 2010; Wu & Lin 2013).

The literature has viewed the implementation of EMA to overcome limitations in conventional management accounting (Jalaludin *et al.,* 2010; Jamil *et al.,* 2015; Khalid *et al.,* 2015) of which, EMA provides monetary and physical environmental information to assess and monitor environmental performance (Jalaludin *et al.,* 2010; Ong *et al.,* 2016). EMA supports decision-making to explicitly track environmental costs and treat environmental actions to contribute in achieving the desired environmental objectives (Jalaludin *et al.,* 2010; Mokhtar *et al.,* 2016; Ong *et al.,* 2016). According to Mokhtar *et al.* (2016), EMA information includes simple to comprehensive activity-based measures and costs that provide valuable information in planning, monitoring, evaluating and decision-making for environmental improvement (Jalaludin *et al.,* 2010; Ong *et al.,* 2016). It enables managers to identify the costs and physical measures that affect the environment.

In Malaysia, EMA adoption is still at its initial stage for many organisations (Jalaludin *et al.,* 2010; Jamil *et al.,* 2015) due to the lack of awareness and not knowing its importance in facilitating decision-making for environmental improvement. The literature has proven that EMA supports ISO 14001 certified organisations to better identify the activities that negatively impact the environment and positively improve environmental protections (Jalaludin *et al.,* 2010; Ong *et al.,* 2016). For instance, Ong *et al.* (2019) confirmed that EMA is capable of identifying positive and negative environmental activities that enhance the ISO 14001 certified organisations' reputation, brand awareness and investors' confidence. Ramli and Ismail (2013) revealed that EMA enabled the ISO 14001 certified organisations to achieve competitive advantage and improve their performance. EMA demonstrates the existing resources that can be used for ISO 14001 certified organisation to provide relevant and reliable environmental information to evaluate, plan and implement GSCPs and EMAs to benchmark ENP to improve ECP.

Drawing from the Natural Resource Based View (NRBV), organisations' collective resources that are rare, valuable and non-substitutable (Hart, 1995) are sources of competitive advantage. Implementing GSCPs anticipates an interconnected strategy for pollution prevention, product stewardship and sustainable development. The adoption of IEM, GP, ECO and RL can be considered strategic resources that collectively and directly improve ENP. It allows Malaysian ISO 14001 certified organisations to maximise environmental reduction initiatives to reduce air emissions, wastewater, solid waste, hazardous or toxic materials and the frequency of environmental accidents (Green *et al.,* 2012; Zhu *et al.,* 2012; Hassan *et al.,* 2016; Tan *et al.,* 2018). Successful GSCPs implementation enhances the ENP (Elated *et al.,* 2011; Zhu *et al.,* 2012). Hence, this study hypothesises that:

H1: Green supply chain practices (GSCPs) directly and positively influence to environmental performance (ENP).

GSCPs are an organisation's strategic resource that integrates suppliers and customers and adopts life-cycle assessment to evaluate environmental loading to minimise emissions, effluents, and waste through continuous improvement efforts. The various stages of interaction and activities can lead to the development of a valid EMA measurement for decision-making on environmental improvement. Chan *et al.* (2014) revealed that the life-cycle oriented green design, including the monetary and physical environmental management accounting information, constitutes a key advantage in EMA development. Zainal *et al.* (2017) indicated that environmental/sustainability-related activities contributed to the development of EMA. Drawing from NRBV, GSCPs is considered an organisation's strategic resource with pollution prevention and production stewardship attributes to support EMA data collection such as handling and disposal costs and physical information regarding the use and flows of energy, water and materials (Zainal *et al.,* 2017). The continuous reduction activities in GSCPs influence the development of EMA. Hence, this study hypothesised that:

H2: Green supply chain practices (GSCPs) directly and positively influence to environmental management accounting (EMA).

The use of EMA to identify the logical significance of changes relative to the benefits of environmental actions reduces negative environmental impacts with a clear vision and direction to achieve an organisation's environmental objectives (Latan *et al.,* 2018). The use of monetary and physical information regarding the energy, water and materials consumption, as well as the generation of waste and emissions, are directly related to an organisation's environmental impacts (Ramli & Ismail, 2013; Mokhtar *et al.,* 2016). According to Sulaiman *et al.* (2010), Jalaludin *et al.* (2010) and Fuzi *et al.,* (2019), EMA information enhances the decision-making process to accurately evaluate the effectiveness of proposed environmental objectives which would improve organisational performance. Albelda (2011) showed a positive influence on the use of EMA and performance evaluation. Drawing from the NRBV's core competencies, EMA supports organisations with monetary and physical environmental information regarding the use, flows, destinations and economic conditions of energy, water, materials and wastes. Hence, this study argues EMA influences to ENP and hypothesises that:

H3: Environmental management accounting (EMA) directly and positively influences to environmental performance (ENP).

ENP and ECP are vital performance measurements used by organisations to assess their opportunities and benefits after the implementation of GSCPs and EMAs as a management strategy (Zhu *et al.,* 2012). The cost-saving nature of ENP leads to economic benefits in identifying the cost return on reduced material purchases, reduced energy consumption and reduced waste treatment and discharge costs (Zhu *et al.,* 2012). Improvements in ENP are expected to result in reducing material purchases, energy consumption and waste treatment, and discharge cost. Zhu *et al.* (2012) revealed ECP improvement could result from ENP improvement due to waste reduction and resources conservation. The literature has shown a positive relationship between ENP and ECP (Green *et al.,* 2012; Zhu *et al.,* 2013). Therefore, this study hypothesises that:

H4: Environmental performance (ENP) directly and positively influences to economic performance (ECP).

Drawing from NRBV, improving ENP indicates better use of organisational resources to reduce environmental risk in material purchased, to have more efficiency on energy consumption and less penalty received in environmental offences (Eltayeb *et al*., 2011; Green *et al*., 2012; Zhu *et al*., 2012). The waste reduction initiatives resulting from complete processing, better utilisation of reused products, and elimination of waste during waste-handling activities and conversion of waste into valuable forms have a positive effect on ECP (Green *et al.,* 2012). Zhu *et al.* (2012) proved that the conversion of waste into valuable forms has a positive effect on ECP. Further, the GSCPs-ENP-ECP relationship anticipates the intra- and inter-organisational reduction actions can ensure the coordination of the respective GSCPs to arrive at better ENP for economic progress to be achieved (Green *et al.,* 2012; Zhu *et al.,* 2012). According to Fraj *et al.* (2013), practices that reduce an organisation's air emissions, effluent waste, solid waste, harmful material consumption and environmental accidents would translate into environmentally-related strategies that in turn lead to competitive advantage in cost-saving. The effect in cost-saving via ENP helps to better explain the relationship between GSCPs and ECP for the ultimate cost-saving and environmental protection. The sustainable competitive advantage achieved through the improvement in ENP enables organisations to achieve pollution prevention, product stewardship, and sustainable development. Hence, this study hypothesises that:

H5: Environmental performance (ENP) mediates the relationship between green supply chain practices (GSCPs) and economic performance (ECP).

Saeidi and Othman (2017) examined the role of process and product innovation in the relationship between EMA and financial performance. Ramli and Ismail (2013) found that effectively reducing the negative environmental impact led to quality improvements in products and services, which improved an organisation's competitive advantage. Being environmentally-conscious can lead to a substantial cost advantage for organisations (Ramli *et al.,* 2013; Mokhtar *et al.,* 2016). The improvement in achieving promising ENP strengthens the relationship between GSCPs, EMAs and ECP. The GSCPs-EMA-ENP-ECP postulates tacit resources to develop an organisation's capability and efficient environmental protection solutions along the supply chain. Drawing from NRBV, the ability of an organisation to associate with the development and deployment of valuable resources develops unique capabilities. The pollution reduction efforts of the application of GSCPs and EMAs can maximise ECP through improvements in ENP. Ultimately, ECP can be achieved through ENP improvement (Green *et al.,* 2012; Ramli *et al.,* 2013). Therefore, this study hypothesises that:

H6: Environmental performance (ENP) mediates the relationship between green supply chain practices (GSCPs), environmental management accounting (EMA) and economic performance (ECP).

As shown in Figure 1, the conceptual model explains the conceptual link between GSCPs, EMA, ENP and ECP under the theory of NRBV.

Methodology

A quantitative survey is employed, and a questionnaire was developed to collect data from the Malaysian ISO 14001 certified organisations registered for more than three years with SIRIM QAS International. The emphasis on the certification years was to ensure the certified organisations are still implementing EMS effectively as defined in the original certification procedures and demonstrated the ability to maintain the ISO 14001 EMS in the manufacturing setting. Particularly, the certification duration anticipates the certified organisations' ability to handle waste in accordance with the documented corrective procedures. A list of 683 ISO 14001 certified companies was obtained from the SIRIM QAS International Malaysian Certified directory

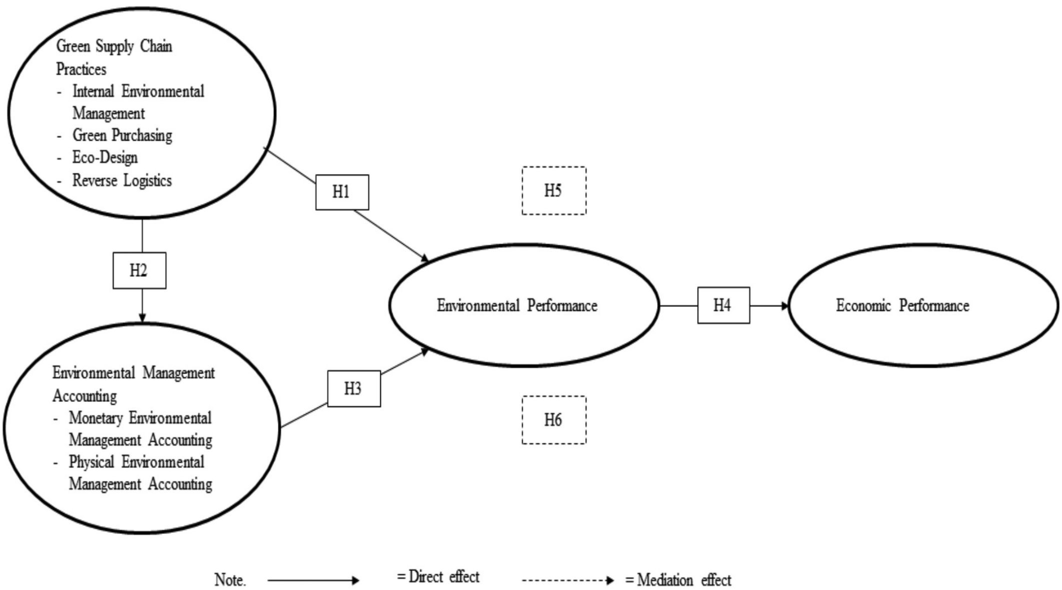

Figure 1: Conceptual model

(SIRIM, 2017) and a total of 399 organisations with three years ISO 14001 certification were selected. The purposive sampling method is to maintain the study's focus on the Malaysian ISO 14001 certified manufacturing organisations which anticipate the responsibility toward environmental protection.

For this study, a cross-sectional questionnaire survey is selected as the primary data collection method. This study utilises measurement items from previously validated scales. The IEM (Darnall *et al.,* 2008; Zhu *et al.,* 2012), GP (Eltayeb *et al.,* 2010; Chin-Chun *et al.,* 2013), ECO (Zailani *et al.,* 2012; Chin-Chun *et al.,* 2013) and RL (Eltayeb *et al.,* 2011; Chin-Chun *et al.,* 2013) were selected and modified from the validated studies mainly because these practices covered the intra- and inter-organisational reduction initiatives, and include the upstream and downstream supply chain partners to close the supply chain loop. Organisational performance inclusive of ENP and ECP were adopted from the studies of Lin *et al.* (2011) and Zhu *et al.* (2012), as both performance measures demonstrate the relevant process and assessment to deliver value and achieve sustainable development. Further, the EMA inclusive of monetary and physical EMA information was adopted from the seven most common practices in Malaysian manufacturing organisations. It was selected from the studies of Jalaludin *et al.* (2010) and Jamil *et al.* (2015). These measurement items are used as the latent constructs to develop the research framework.

A total of 40 measurement items are used in this study. The constructs of IEM, GP and ECO have six measurement items each. The RL, ENP and ECP, each has five measurement items, and monetary EMA has three measurement items, while physical EMA has four measurement items. The 5-point scale ranging from "1" (not at all) to "5" (great extent) was deployed to gauge the level of involvement in environmental protection practices in GSCPs and EMA. Meanwhile, organisational performance (ENP and ECP) were measured using the recommendation made by Lin *et al.* (2011) and Zhu *et al.* (2012) and the measurements are based on a 5-point scale ranging from 1 = significantly below to 5 = significantly above that measure the organisation's performance over the past three years. Table 1 summarises the total number of items that measure each construct.

Table 1: Total number of items to measure each construct

	Constructs	Number of items	Source
1.	Internal Management System (IEM)	6 items	(Darnall *et al.*, 2008; Zhu *et al.*, 2012)
2.	Green Purchase (GP)	6 items	(Eltayeb *et al.*, 2010; Chin-Chun *et al.*, 2013)
3.	Eco-Design (ECO)	6 items	(Zailani *et al.*, 2012; Chin-Chun *et al.*, 2013)
4.	Reverse logistics (RL)	5 items	(Eltayeb *et al.*, 2011; Chin-Chun *et al.*, 2013)
5.	Monetary Environmental Management Accounting (MEMA)	3 items	(Jalaludin *et al.*, 2010; Jamil *et al.*, 2015)
6.	Physical Environmental Management Accounting (PEMA)	4 items	(Jalaludin *et al.*, 2010; Jamil *et al.*, 2015)
7.	Environmental Performance (ENP)	5 items	(Lin *et al.*, 2011; Zhu *et al.*, 2012)
8.	Economic Performance (ECP)	5 items	(Lin *et al.*, 2011; Zhu *et al.*, 2012)
	Total	**40 items**	

Partial Least Squares (SmartPLS3) and the Statistic Package for Social Science (SPSS) were employed for the data analysis. The measurement model analysis was satisfactory through the comprehensive reliability and validity assessment inclusive of the convergent and discriminant validity. In this study, the indicators values for each construct of IEM, GP, ECO, RL, EMA, ENP and ECP are assigned to form the reflective measurement model under the NRBV theoretical perspective. The primary objective is to discover new insights into the relationship between GSCPs and EMAs to ENP and final cost-saving in ECP. Therefore, the Principal Component Analysis (PCA) with varimax rotation is employed to minimise the items that can best explain the latent construct. The bootstrapping procedure that used 5,000 samples with replacement was employed to test the significance of the path coefficients and their associated t-values. This study with a one-tailed test and the t-value greater than 2.33 is significant at the level of 0.01. A t-value greater than 1.65 is significant at the level of 0.05; and a t-value greater than 1.28 is significant at the level of 0.10.

In this study, the second-order construct was applied to estimate the GSCPs (IEM, GP, ECO and RL) by using the repeated indicator approach. The higher-order measurement model is appropriate because it includes all manifest variables which are underlying of the first-order latent variables (Lohmöller, 2013) to predict the same general level of abstraction. Suggested by Hair *et al.* (2012), item loading, composite reliability and AVE are to be included to assess for the validity of the second-ordered construct. The significance requirement for t-value is to be expected higher than 1.96 with p-value significant at $p<0.05$. The internal consistency and composite reliability were required to exceed the recommended value of 0.7 (Nunnally, 1978) and AVE required to have the minimum value of 0.5 (Hair *et al.*, 2010) for adequate convergence. According to Hair *et al.,* (2017), the validation of the measurement model needs to ensure the extent of each observable to measure the same construct and is consistent with the construct. Hence, this study examines the predictive relevance of the model by exploring the Q^2 value through blindfolding assessment in SmartPLS3. The R^2 and Q^2 values explain the relevance and significant predictive measure for reflective measurement model.

To investigate the interrelationships of GSCPs, EMA, ENP and ECP, the structural model was conducted to assess the significance of the path coefficient. The key assessment of the structural model focuses on the significance of the path coefficient, the level of the R-squares (R^2) of the endogenous constructs and the evaluation of the Variance Accounted For (VAF) to ascertain the mediation effects and the strength or the portion of the mediation effects. According to Hari *et al.* (2017), VAF determines the size of the indirect effect in relation to the total effects. The ratio of the indirect-to-total effect determines the degree to which the mediation process explains the dependent variable. The significance of VAF is estimated between 20% and 80% (Hair *et al.*, 2012; Nitzl *et al.*, 2016). The mediation assessment is expected to offer better insight into the mediation consequence of ENP and EMA as hypothesised in this study. It is important to estimate the extensions of the mediators with the help of the decomposition of direct, indirect and total effects.

Results and Discussions

Data collection was conducted from October 2017 to February 2018. A total of 399 sets of questionnaires were sent to the EMRs via post, personal distribution as well as through electronic mail. Out of that, 121 completed and usable sets of questionnaires were returned and yielded a response rate of 30.3%. Based on the results, more than half of the respondents (53.7%) have three or more years' experience, and the majority of the firms have more than nine years of certification duration (57.0%). With regard to the nature of business, a higher number of firms belong to the electrical and electronics industry with 37.2% followed by plant and machinery with 22.3%, chemical and material with 18.2%, oil and gas and energy with 5.8%, transport equipment and automatic together with service sectors with 4.1% respectively.

For 23 items related to GSCPs, there are relatively high levels of IEM practice with the mean score ranging from 3.58 to 4.33 and GP mean score ranging from 3.43 to 4.17. Moderate level for ECO practice with the mean score ranging from 3.54 to 3.82, and slightly low RL practice with the mean score ranging from 2.83 to 3.22. The descriptive data analysis revealed the ISO 14001 certified firms in Malaysia are practising moderate to high levels of GSCPs. This aligns with the study by Eltayeb *et al.* (2011), which indicated growing attention to GSCPs implementation in Malaysian manufacturing firms. For EMA implementation, both physical and monetary EMA demonstrate moderate emphasis and are used when making decisions on environmental improvements as well as benchmarking for environmental performance. The mean scores ranged from 3.57 to 3.96. Increased awareness in EMA implementation is observed. The result is in line with Jamil *et al.* (2015), which indicated the EMA as less significant aspect in the internal management system and has anticipated low to moderate implementation in Malaysian firms.

The initial factor analysis for all the 40 items was tested. The IEM5 and reverse logistics were loaded as a single factor. The IEM5 measured the scheduled solid waste disposal activities which involved the scheduling of waste collection with the third-party in handing scheduled waste. The IEM5 has the common in returning of the organisations' solid waste to save landfill. Hence, the new factors concluded to merge the IEM5 and reverse logistics into one component. Further, the principal components factor analysis and an un-rotated factor analysis extracted eight factors which reverse logistics (RL1, RL2, RL3, RL4, RL5 and RL6) split into two components. Therefore, the decision was to divide the reverse logistics (RL) into two factors and rename as Collection from Customer (CC) and Return to Supplier (RS) representing the post-supply chain initiatives.

Table 2 shows the composite reliability value for IEM (0.876), GP (0.928), ECO (0.938), CC (0.904), SR (0.873), EMA (0.956), ENP (0.956) and ECP (0.937) were all greater than the 0.70 threshold. The minimum cut-off value for AVE (>0.50) were satisfied by 0.586 (IEM), 0.638 (GP), 0.718 (ECO), 0.826 (CC), 0.634 (RS), 0.755 (EMA), 0.814 (ENP) and 0.752 (ECP) accordingly. The eight factors explained the cumulative variance of 77.00%. The factor

Table 2: Item loading, composite reliability and average variance extract

Variables	Item Code	Item Loading	CRA (α)	Pc	AVE
Internal Environmental Management (IEM)	IEM1	0.821	0.825	0.876	0.586
	IEM2	0.775			
	IEM3	0.760			
	IEM4	0.758			
	IEM6	0.711			
Green Purchasing (GP)	GP1	0.846	0.906	0.928	0.683
	GP2	0.899			
	GP3	0.839			
	GP4	0.819			
	GP5	0.698			
	GP6	0.844			
Eco Design (ECO)	ECO1	0.875	0.923	0.938	0.718
	ECO2	0.865			
	ECO3	0.866			
	ECO4	0.800			
	ECO5	0.870			
	ECO6	0.803			
Collection from Customer (CC)	CC1	0.841	0.817	0.904	0.826
	CC2	0.972			
Return to Supplier (RS)	RS1	0.796	0.819	0.873	0.634
	RS2	0.804			
	RS3	0.859			
	RS4	0.718			
Environmental Management Accounting (EMA)	EMA1	0.858	0.946	0.956	0.755
	EMA2	0.918			
	EMA3	0.901			
	EMA4	0.868			
	EMA5	0.859			
	EMA6	0.823			
	EMA7	0.854			
Environmental Performance (ENP)	ENP1	0.868	0.943	0.956	0.814
	ENP2	0.916			
	ENP3	0.934			
	ENP4	0.931			
	ENP5	0.860			
Economic Performance (ECP)	ECP1	0.914	0.912	0.937	0.752
	ECP2	0.885			
	ECP3	0.943			
	ECP4	0.927			
	ECP5	0.626			

analysis for the GSCP construct was concluded that all the 23 items of the GSCP construct were satisfied with new coded of IEM, GP, ECO, CC, SR, EMA, ENP and ECP.

Table 3 shows the discriminant validity of all constructs. The square root of AVE's value for the following: IEM, GP, ECO, CC, RS, EMA, ENP and ECP along the diagonal are greater than the correlation value of other constructs.

Table 4 shows the cross-loadings of all constructs. The factor structure matrix exhibited high loadings on each construct, which ranged from the minimum loading of 0.626 to the maximum loading of 0.972. No cross-loading was observed. All item loadings were adequately loaded on the respective construct. The statistical evidence exhibited the IEM, GP, ECO, CC, RS, EMA, ENP and ECP represent the underlying concept of this study accurately.

The GSCPs were tested in the first-order measurement model with 23 indicators (loadings) and were used as the composite score in the second-order construct. The higher-order constructs demonstrate a better explanation of the underlying theory that is related to the constructs. The first-order factor model was run to obtain the composite score of each latent variable by using SPSS. The five latent variables scores were saved and used in the second-order factor model construct via SmarPLS3. Table 5 exhibits the validation of the second-order construct for GSCP with t-value ranging from 2.371 to 13.166 which higher than the critical value of 1.96. All of the second-order constructs were significant at $p < 0.05$ at the 95% confidence. The composite reliability showed 0.870 which is well above the threshold of 0.70. The AVE was above the acceptable range of 0.575 (threshold >0.50). It is concluded that the reliability coefficients for all sub-constructs were obtained. Therefore, the second-order factor was considered appropriate to use in the structural model analysis.

For the evaluation of the model's predictive relevancy, the squared correlation (R^2 and Q^2) of each endogenous construct was examined. Table 6 illustrates all the endogenous constructs of this study. The R^2 and Q^2 values demonstrate relatively important predictive measure for EMA ($R^2 = 0.621$; $Q^2 = 0.600$), ENP ($R^2 = 0.383$; $Q^2 = 0.351$) and ECP ($R^2 = 0.595$; $Q^2 = 0.557$). The result revealed that the model is highly predictive as the values of the Q^2 predictive relevance is above the threshold of zero. Hence, the reflective measurement model is satisfied with the predictive accuracy.

Figure 2 shows the structural model of this study, which was designed to investigate the interrelationships of the GSCPs (second-ordered) and EMA influence on ENP and ECP. As a result, a total of five paths were analysed. The path coefficients have standardised values between -1 and +1, where the path coefficient value close to +1 indicated a strong positive relationship. Conversely, the estimated coefficient values close to zero or -1 are usually not significant.

Table 3: Correlation of latent variables for all constructs

	IEM	GP	ECO	CC	RS	EMA	ENP	ECP
IEM	**0.766**							
GP	0.440	**0.862**						
ECO	0.489	0.595	**0.847**					
CC	0.361	0.346	0.354	**0.909**				
RS	0.544	0.566	0.576	0.507	**0.796**			
EMA	0.756	0.606	0.544	0.377	0.560	**0.869**		
ENP	0.662	0.224	0.456	0.306	0.418	0.582	**0.902**	
ECP	0.649	0.152	0.373	0.192	0.342	0.540	0.761	**0.867**

Table 4: Cross-loading for all constructs

	IEM	GP	ECO	CC	RS	EMA	ENP	ECP
IEM1	**0.821**	0.369	0.352	0.308	0.382	0.713	0.488	0.468
IEM2	**0.775**	0.491	0.385	0.354	0.431	0.635	0.456	0.390
IEM3	**0.760**	0.301	0.364	0.210	0.343	0.636	0.394	0.451
IEM4	**0.758**	0.344	0.394	0.292	0.349	0.611	0.508	0.521
IEM6	**0.711**	0.209	0.368	0.220	0.525	0.449	0.622	0.600
GP1	0.407	**0.846**	0.489	0.295	0.528	0.511	0.184	0.124
GP2	0.469	**0.899**	0.496	0.364	0.453	0.596	0.225	0.195
GP3	0.345	**0.839**	0.479	0.303	0.381	0.471	0.181	0.171
GP4	0.378	**0.819**	0.528	0.189	0.436	0.523	0.135	0.124
GP5	0.255	**0.697**	0.485	0.198	0.523	0.346	0.183	0.117
GP6	0.307	**0.844**	0.483	0.327	0.481	0.545	0.181	0.007
ECO1	0.496	0.535	**0.875**	0.322	0.574	0.530	0.510	0.403
ECO2	0.419	0.403	**0.865**	0.319	0.442	0.381	0.457	0.356
ECO3	0.446	0.524	**0.866**	0.329	0.513	0.550	0.385	0.376
ECO4	0.294	0.564	**0.800**	0.267	0.533	0.380	0.182	0.164
ECO5	0.399	0.586	**0.870**	0.272	0.470	0.464	0.327	0.270
ECO6	0.340	0.483	**0.803**	0.262	0.397	0.424	0.273	0.183
CC1	0.219	0.287	0.205	**0.841**	0.339	0.257	0.149	-0.035
CC2	0.388	0.338	0.384	**0.972**	0.530	0.392	0.345	0.271
RS1	0.359	0.616	0.449	0.490	**0.796**	0.467	0.217	0.139
RS2	0.242	0.513	0.415	0.385	**0.803**	0.356	0.193	0.152
RS3	0.459	0.514	0.494	0.487	**0.859**	0.554	0.354	0.325
RS4	0.522	0.273	0.442	0.288	**0.718**	0.374	0.428	0.343
EMA1	0.709	0.480	0.436	0.287	0.471	**0.858**	0.583	0.573
EMA2	0.746	0.500	0.438	0.314	0.481	**0.918**	0.559	0.527
EMA3	0.686	0.568	0.492	0.352	0.511	**0.901**	0.544	0.445
EMA4	0.661	0.593	0.545	0.291	0.527	**0.868**	0.447	0.477
EMA5	0.702	0.462	0.474	0.279	0.423	**0.859**	0.523	0.520
EMA6	0.616	0.516	0.437	0.403	0.510	**0.823**	0.429	0.364
EMA7	0.637	0.607	0.515	0.400	0.508	**0.854**	0.407	0.321
ENP1	0.525	0.159	0.345	0.267	0.346	0.445	**0.866**	0.619
ENP2	0.603	0.181	0.420	0.249	0.296	0.533	**0.914**	0.702
ENP3	0.670	0.256	0.428	0.276	0.422	0.572	**0.933**	0.769
ENP4	0.618	0.178	0.444	0.288	0.406	0.557	**0.932**	0.703
ENP5	0.559	0.229	0.414	0.303	0.408	0.509	**0.865**	0.629
ECP1	0.599	0.141	0.340	0.198	0.287	0.536	0.718	**0.914**
ECP2	0.559	0.086	0.270	0.242	0.275	0.492	0.667	**0.885**
ECP3	0.611	0.131	0.342	0.142	0.341	0.463	0.699	**0.943**
ECP4	0.612	0.164	0.360	0.129	0.353	0.487	0.687	**0.927**
ECP5	0.408	0.143	0.311	0.113	0.213	0.344	0.508	**0.626**

Table 5: Validating of second-order GSCP construct

GSCP Construct	Loading	Std. Error	T-value	P-value	95% CI
Internal Environmental Management (IEM)	0.826	0.050	13.166	0.000	(0.577 ,0.741)
Green Purchasing (GP)	0.705	0.094	2.371	0.009	(0.069,0.374)
Eco-Design (ECO)	0.789	0.086	5.271	0.000	(0.308,0.591)
Collection from Customer (CC)	0.622	0.085	3.611	0.000	(0.166.0.442)
Return to Supplier (RS)	0.826	0.085	4.910	0.000	(0.267, 0.544)
Pc = 0.870 AVE = 0.574					

Key: Pc = Composite Reliability AVE = Average variance Extracted CI = Confidence Interval

Table 6: Relative importance of the endogenous construct

Endogenous Constructs	R^2 Value	Q^2 Value
EMA	0.621	0.600
ENP	0.383	0.351
ECP	0.595	0.557

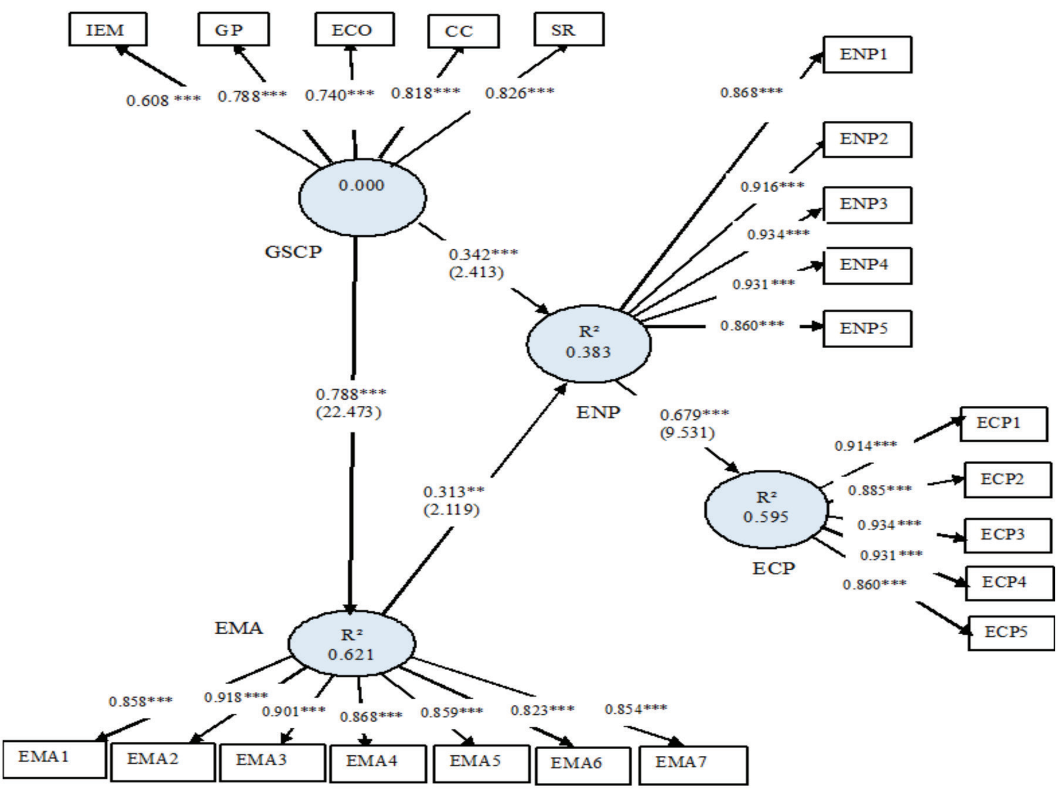

Figure 2: Structural model of path coefficient

The results illustrate the path coefficient t-values, the GSCPs were revealed to be positively related to ENP (Beta = 0.342, $p < 0.01$), GSCPs positively related to EMA (Beta = 0.788, $p < 0.01$), EMA positively related to ENP (Beta = 0.313, $p < 0.05$) and ENP positively related to ECP (Beta = 0.679, $p<0.01$). Table 7 summarises the direct path coefficient's statistical results.

The squared correlation (R^2) of each endogenous construct was examined. Referring to Figure 2, 62.1% of the variance in EMA is explained by the GSCPs construct, 38.3% of the variance of ENP is explained by both the exogenous construct of GSCPs and EMA and 59.9% of the variance of ECP can be explained by the exogenous variables of GSCPs, EMA and ENP. The model's predictive accuracy is satisfactory and relevant in explaining the relationship from exogenous construct to endogenous construct.

Table 7 also presents the results of hypotheses testing. The structural path coefficient between the GSCPs construct, and the ENP construct is positive and statistically significant at a p-value <0.01. The path coefficient (β = 0.342) explained the positive and direct relationship between GSCPs and ENP. In addition, the t-value (t = 2.413) represents the significance of the relationship in the bootstrapping is critical (greater than 1.645 < 0.05) at 95% confidence level. Hence, H1 is significant and supported.

In addition, the findings revealed a statistically significant beta path coefficient between GSCPs and EMA. The results indicate a positive direct relationship between the two constructs at p-value < 0.01. The beta path coefficient (β = 0.788) explained the positive and direct relation between GSCPs and EMA. Conversely, the t-value (t = 22.473) indicated the significant and appropriate bootstrapping level of 95% confidence. Hence, H2 is supported.

As specified in Table 7, H3 revealed the path coefficient (β = 0.313), T statistic (t = 2.119) and *p*-value <0.05 were statistically significant. The beta path coefficient (β = 0.313) demonstrated a positive and direct relationship between EMA and ENP. The T statistic (t = 2.119) and *p*-value <0.05 indicated the significance at the 95% confidence level. Thus, H3 is significantly supported. H4 predicted a positive and direct relationship between ENP and ECP. The result revealed that the path coefficient between the ENP and ECP is statistically significant at a *p*-value <0.01. The beta value (β = 0.679) and T statistic (t = 9.531) of 95% confidence level

Table 7: Results of path coefficient - direct effects

	Relationships		Beta Value	Std. Error	t-value	p-value	Decision
H1	GSCP	ENP	0.342	0.142	2.413	0.008***	Supported
H2	GSCP	EMA	0.788	0.035	22.473	0.000***	Supported
H3	EMA	ENP	0.313	0.148	2.119	0.017**	Supported
H4	ENP	ECP	0.679	0.071	9.531	0.000***	Supported

Note: *** significant at p-value < 0.01, ** significant at p-value < 0.05, * significant at p-value < 0.10

Table 8: Results of path coefficient - indirect effects

	Relationship				Indirect Effect	t-value	LL (5%)	UL (95%)	Decision
H5	GSCP	ENP	ECP		0.232	2.251**	0.074	0.414	Supported
H6	GSCP	EMA	ENP	ECP	0.167	2.033**	0.032	0.306	Supported

Note: *** significant at *p*-value < 0.01, ** significant at *p*-value < 0.05, * significant at *p*-value < 0.10

further validated this hypothesis. Hence, H4 is significantly supported.

The investigation of the indirect effect explained the type of intermediate relationship that predicts the endogenous construct via the mediating effect. The bootstrapping procedure is employed to test the mediation effects at the 95% confidence interval (one-tail test). Table 8 exhibits the mediation effect of H5 and H6. The results revealed the link between GSCPs and ECP through the mediating effect of ENP is significant at a p-value of <0.05 (t-value 2.251; LL 0.074; UL 0.414). Hence, H5 is supported. Likewise, the indirect relationship between GSCP, EMA and ECP through the mediation effect of ENP is demonstrated to be statistically significant with a p-value <0.05 (t-value is 2.033; LL is 0.032 and UL is 0.306). The H6 is therefore supported here.

The VAF provides deeper insights into the size of the mediation effects (indirect effect/total effect). As for the results of VAF in Table 9, they show the relationship between GSCP and ECP is partially mediated by ENP with the VAF of 45.66% (greater than 20% and less than 80%). The last mediation relationship between GSCP and ENP through the intermediation relationship of EMA and ENP indicated partial mediation with VAF 45.38% (greater than 20% and less than 80%). According to Hair *et al.* (2013), the VAF greater than 80% indicates full mediation; a situation in which the VAF is greater than 20% and less than 80% could be categorised as partial mediation; and VAF less than 20% is considered no mediation (Hair *et al.*, 2012; Nitzl *et al.*, 2016). Hence, the VAF result confirmed that the relationship between GSCP and ENP is partially mediated by EMA and ENP.

As summarised in Table 10, all the hypotheses testing proposed by this study are significantly supported. The findings strongly supported the hypotheses H1 (GSCP and ENP), H2 (GSCP and EMA), H3 (EMA and ENP), H4 (ENP and ECP) and the indirect relationship H5 (GSCP-ENP-ECP) and H6 (GSCP-EMA-ENP-ECP).

Hypothesis 1 was supported at a p-value < 0.01. The positive testing result confirms the theoretical notion that the collective GSCPs representing the intra- and inter-organisational integration of valuable resources directly lead to the improvement in environmental performance. Consistent with Green *et al.* (2012), the implementation of various GSCPs practices such as IEM, GP, ECO, CC and RS may lead to the improvement in waste management. Particularly, the reduction in air emissions, effluent waste, solid waste, hazardous or harmful

Table 9: Results of VAF

	Structural Path	Indirect Effect	Total Effect	t-value	VAF (%)	Mediation
H5	GSCP à ENP à ECP	0.232	0.508	5.665***	45.66	Partial
H6	GSCP à EMA à ENP à ECP	0.167	0.368	2.099**	45.38	Partial

Table 10: Hypotheses testing

	Relationships	Beta Value	Std. Error	t-value	Decision
H1	GSCP ENP	0.342	0.142	2.413**	Supported
H2	GSCP EMA	0.788	0.035	22.473***	Supported
H3	EMA ENP	0.313	0.148	2.119**	Supported
H4	ENP ECP	0.679	0.071	9.531***	Supported
H5	GSCP ENP ECP	0.523	0.092	5.665***	Supported
H6	GSCP EMA ENP ECP	0.167	0.082	2.033**	Supported

Note: *** significant at *p*-value < 0.01, ** significant at *p*-value < 0.05, * significant at *p*-value < 0.10

material consumption and environmental accidents (Eltayeb *et al.,* 2011; Lin *et al.,* 2011; Zhu *et al.,* 2012). The findings are consistent with Zhu *et al.'s* (2012) study which claimed that the appropriate collaboration between the intra- and inter-organisational environmental efforts impact on environmental performance. The emissions and waste are reduced, changed and prevented through the strategic actions along the supply chain.

Further, the findings revealed a statistically significant beta path coefficient between GSCPs and EMAs. The results indicate a very strong positive direct relationship between the two constructs at a p-value < 0.01 which hypothesized in H2. The result indicated that the greater the extent of emphasis on GSCPs, the greater the emphasis on EMAs. The implementation of GSCPs has a strong impact on the development of environmental management accounting (Khalid *et al.,* 2015) through revealing the hidden environmental costs such as the usage and flow of water, energy and material. The considerable environment-related activities that involve customers and suppliers further supported the contribution to the environmental-related hidden cost (Makhtar *et al.,* 2016; Khalid *et al.,* 2015; Burritt & Schaltegger, 2014; Ramli *et al.,* 2013). GSCPs provide essential data for environmental management ranging from simple to comprehensive methods that link physical and monetary information to decision-making. It is consistent with Khalid *et al.* (2015) who found that ISO 14001 certified organisations in Malaysia consider environmental information in their management accounting system and run cost-benefit analysis when making decisions concerning environmental issues.

Hypothesis 3 argued that EMA influences ENP. The results found a positive and direct relationship between EMA and ENP at a p-value <0.05. The findings indicate that the monetary and physical environmental information influence the reduction in air emissions, effluent waste, solid waste, harmful material consumption and environmental accidents. The findings support Latan *et al.* (2018) who found that EMA generates more precise information in tracking the flow and usage of water, energy and material with the generation of waste, emission and harmful material consumption. This is also consistent with Jalaludin *et al.* (2010) who found that EMA has a positive and direct relationship with ENP.

Hypothesis 4 proposed that there is a direct and positive relationship between environmental performance (ENP) and economic performance (ECP). The structural path coefficient between the ENP and ECP is statistically significant at a *p*-value <0.01. The findings revealed that decreasing emissions, waste, hazardous/toxic materials consumption and environmental accident led to lower costs for discharge and treatment for waste, cost of material and energy consumption and penalties for environmental accidents (Lin *et al.,* 2011; Zhu *et al.,* 2012). The cost-saving nature of environmental performance can lead to economic benefits by identifying the cost return in energy consumption, material purchase, producing of environmentally friendly products and collection of used product or material for recycling and reused. This is also supported by Zhu *et al.* (2012) who contended that achievement in environmental performance could lead to positive economic performance. The findings are consistent with Green *et al.* (2012), who found that improvements in environmental performance can reduce material purchases, energy consumption, waste treatment and discharge cost. This is also supported by Zhu *et al.* (2012) who contended that achievement in environmental performance could lead to positive economic performance.

This study proposed in Hypothesis 5 that there is an indirect relationship between GSCPs, ENP and ECP. The result revealed that the indirect effect of GSCP on ECP via ENP is significant at a p-value <0.01. The bootstrapping confidence interval (95%) further revealed the significance of the indirect relationship with the confident value greater than zero and consistent with the study conducted by Zhu et al. (2012) which found that ECP was identified in cost-saving that arises from the efficient implementation of the GSCPs and improvement in environmental performance. The results also supported by Green *et al.* (2012) found that environmental performance mediates the decision-making in identifying the value-added activities and eliminating or reducing non-value-added activities which resulted in minimising of environmental expenditure, cost of material purchase and energy consumption. The findings demonstrate that environmental performance mediates the integration of the intra- and inter-organisational environmental practices which focus on reducing, reusing and recycling initiatives resulting in cost reduction for material purchase, energy consumption, waste treatment and reduction of penalty on environmental offences.

In addition, Hypothesis 6 proposed that environmental performance mediates the relationship between green supply chain practices (GSCPs), environmental management accounting (EMA) and economic performance (ECP). The results revealed that the indirect effect of GSCPS on EMA and ECP via ENP is also significant at a p-value <0.05. The findings indicate that the mediation role of environmental performance also facilitates the implementation of EMA on the environmental impacts and the financial consequences of environmentally-relevant business activities. This study supports Jalaludin *et al.* (2010), who found a significant and positive correlation between EMA adoption level and environmental performance and economic performance. Zhu *et al.* (2012) further supported the mediation role of environmental performance to the improvement in economic performance. Using environmental performance to benchmark and evaluate the cost-saving programme that supports organisations to become more efficient and effective in providing organisations with a clear picture of which environmental-related activities support more cost-saving.

The findings suggest that the ISO 14001 certified organisations should be aware of the impact of GSCPs on economic performance indirectly through the improvement in environmental performance. In addition, the adoption of environmental management accounting information facilitates the ISO 14001 certified organisations with relevant and reliable environmental information to improve environmental performance which, in turn, facilitate organisations to benchmark and evaluate the cost-saving program. Organisations become more efficient and effective in providing organisations with a clear picture of which environmental-related activities support more cost-saving.

Conclusion

The aim of this study was to investigate the interaction of GSCPs, EMA, ENP and ECP, leverage from implementing GSCPs and EMA beneficial analysis, this study investigates the relationship between GSCPs and EMA and the improvement of environmental and economic performance. The empirical results show that structural relationships exist with the adoption of GSCPs, EMA, ENP and ECP. The result supported the assumption that economic benefits in cost reduction could be actualised by focusing on environmental improvements. The findings imply that organisations that emphasised on greening their supply chain will benefit from the pool of more advanced EMAs information to better identify costs and value-adding processes across their traditional organisational boundaries, which, in turn, will improve the environmental and economic performance. The result reflects the significance of adopting collective environmental-related practices to achieve promising cost-saving and sustainable development. Business operation activities which incorporate the implementation of GSCPs can be realised by explicitly recognising material and energy flows within the business operations. This study signifies that GSCPs and EMA are valuable resources that benefit the environment by reducing waste through better communication and sharing of environmental information.

The findings contribute insights into how ISO 14001 certified organisations can gain improved economic performance by implementing GSCPs and adopting relevant and reliable information from EMA to identify the key sustainability drivers facilitating the appropriation of the potential benefits in cost-saving and environmental protection. Operation managers and accountants can gain insights into how GSCPs and EMA provide transparency in developing better provisions for environmental risk assessments, environmental costing determinations, environmental investment decisions and compliance to environmental accounting regulations. EMRs which focus on environment-related tools could introduce real-time and higher quality data to measure ENP and ECP. This study has also contributed to a better understanding of the mediating effects of ENP to explain the resources used to support the green initiatives within the supply chain in order to enhance cost-savings in an organisation. The initial devotion of resources, time and commitment, are usually not actualised in the short period but through the successful achievement in reducing waste and lesser consumption of material and energy. The findings of this study strengthen the significance of the indirect effect of environmental performance in assisting organisations to meet environmental responsibilities through the process of evaluating environmental performance and identifying the economic benefits of improved environmental performance.

Nevertheless, the focus of this study on the implementation of GSCPs and EMA of individual organisation limited the scope of data availability in the development of the new vision of sustainable development. Future studies may consider incorporating Industry 4.0 as the fourth industrial revolution infrastructure designed to digitise business. Environment-related practices should consider to link supply chain partners and organisations to secure the benefits of cost reduction. Industry 4.0 is expected to produce superior data, especially about opportunities for pollution and waste prevention. Therefore, environmental-related practices could design with digital data made available in real-time to monitor and certify optimal corporate environmental and economic performance. The present study employs a pure quantitative research technique (100% self-administered survey) to include more in-depth responses, as well as non-verbal communication data. Findings may provide insights and be captured through qualitative or mixed research methods. The GSCP-EMA is still considered as new environmental practices to many organisations. The establishment of GSCP-EMA possesses the capacity to serve as fundamental standard operating procedures (SOP) or guidelines to achieve environmental and economic performance in other emerging economies as well. The present study only focuses on Malaysian ISO 14001 certified manufacturing organisations. Thus, future researchers may consider broadening the scope of the study by extending the target research areas to cover more geographical areas such as other Asian, European and American countries to compare findings in developing and developed countries and to enhance the generalisation of the new positions of GSCPs and EMAs to the influence in ENP and ECP.

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