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The Mediating Roles of Supply Chain Quality Integration and Green Logistics Management Between Information Technology and Organisational Performance

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Abstract

The paper primarily investigates the relationship between information technology, supply chain quality integration, green logistics management and organisational performance. The mediating roles of supply chain quality integration and green logistics management are further examined. The unit of analysis is small and medium enterprises in Ghana. A survey data collected from 280 tactical and strategic managers through questionnaires are analysed using SmartPLS-3. All the hypotheses are supported and accepted. The findings of the analysis establish positive relationships between the exogenous and endogenous variables. It is discovered that supply chain quality integration and green logistics management play intermediary roles between information technology and organisational performance. Moreover, the results show that supply chain quality integration mediates the relationship between information technology and organisational performance. Limitations and future research areas are discussed in work.

Keywords: Green Logistics Management, Information Technology, Organisational Performance, Supply Chain Quality Integration

Introduction

Global warming has evolved to become one of the dangerous threats to the continuity of civilisation. It is recognised as the force behind the recent harsh climatic conditions experienced all over the world. Global warming is blamed for the intensity of cyclone Idai, which claimed over 1200 human lives and destroyed billions of dollars' worth of properties in Mozambique, Malawi and Zimbabwe in March 2019 as well as several other life-threatening occurrences in other places.

The greenhouse effect is fundamental to global warming. Carbon dioxide (CO_2) emission is the backbone of the greenhouse effect. This results from the excessive use of fossil fuels and depletion of forest reserves, which emanate primarily from logistics and manufacturing activities across the globe. Many scholars argue that the activities of suppliers, distributors and customers rather than manufacturers cause the major environmental challenges (Zhu & Sarkis, 2007; Rao, 2019; Lai et al., 2013).

These challenges have caused several nongovernmental agencies and other stakeholders to agitate for laws and policies to ensure sustainability. Some studies assert that the occurrence of unpleasant phenomena creates the awareness about sustainability among stakeholders (Buysse & Verbeke, 2003; Gonzalez-Benito & Gonzalez-Benito, 2006; Shrivastava et al., 1988) which triggers the demand for policies and regulations that ensure environmental safety and sustainability.

CO_2 emission and reverse logistics are some crucial thematic areas considered in green logistics concept. CO_2 emission and waste of resources can be reduced or eliminated through sustainable green practices. The concept of green logistics can be effectively implemented by considering inbound logistics, in-house supply chain or production processes, outbound logistics and reverse

logistics (Sarkis, 1999; Rao, 2002; Rao & Holt, 2005; Rao, 2007; Rao 2019; Seuring & Muller, 2007).

Green logistics practices ensure the safety of the environment through the use of clean fuel, recyclable packages, products and renewable energy. The practical implementation of sustainable logistics practices falls short due to its substantial financial burden and high volatile financial outcome. However, some firms recognise the need to go green to enhance their competitive standing through the enhancement of firm reputation.

Firms which implement green policies to cover only their internal processes are not likely to make an enormous environmental impact on securing an impactful competitive position. Companies which make and implement green policies have recognised the need to ensure that sustainability covers their entire scope of operation, which encapsulates customers, suppliers, handlers, warehousing, transportation and other business processes (Cervera & Flores, 2012; Mani et al., 2015).

Sharing of information and making of cooperative decision on quality coupled with coordination in pricing and contract of emission is essential for effective implementation of green logistics practices (Dekker et al., 2012). Both internal and external (upstream and downstream) supply chain quality integration practices have become essential drivers of competitive advantage (Sarkis, 2012; Srivastava, 2007; Sarkis et al., 2012; Bai & Sarkis, 2010) due to less waste of resources and quality improvement along the supply chain.

According to Rao (2005) and Markley and Davis (2007), firms which take proactive steps to lead the adoption of sustainable practices along its supply chain, develop a difficult-to-copy competitive advantage by satisfying their customers and improving on their performance. Some scholarships posit that it is critical for firms which are involved in environmental initiatives and programmes to collaborate with their supply chain partners, create the awareness about the environment and enhance their environmental protection capabilities (Ates et al., 2012; Wilhelm et al., 2016).

Green practices cannot be effectively implemented without the application of advanced information technology systems. Various technological tools and systems have been built to aid the implementation and insurance of sustainable logistics practices. These systems include electronic data interchange (EDI), warehouse management systems, transportation management systems, radio frequency identification (RFID) and enterprise resource planning (ERP) (Franklin 2018; Ha et al., 2014).

Information technology has the tendency to improve the implementation of green logistics activities through the use of developed systems which ensures that resources are not wasted, clean fuels are used and develop packages and products that can be recycled. This leads to improved operational and reputation performance. Information technology ensures that quality is achieved with little resources and waste is recycled for other use which safeguards our environment. This results in the achievement of sustainability and development of competitive capabilities to enhance performance.

Ghana, like any other country, is facing the challenge of environmental pollution which stems from organisational activities. Several firms who have failed to deal with environmental pollution through the adoption of green logistics practices decry of financial challenges and little returns from such investments. The question, "Does it pay to be green?", has been dramatically assessed by many researchers and firms (Ambec & Lanoie, 2008; Hart & Ahuja, 1996).

According to Rao (2019), the environmental sustainability of small and medium enterprises is crucial to the greening of the supply chain. Prior studies have called for further investigation into the suggestion that firms who are committed to taking proactive steps towards green supply chain practices gain competitive position (Ambec & Lanoie, 2008; Ateş et al., 2012; Orlitzky et al., 2003).

Again, this study will clarify whether the ambiguous and contradictory findings of prior studies (Eltayeb et al., 2011; Golicic & Smith, 2013; Yang et al., 2011) could be attributed to the scope and approaches to measuring green supply chain management practices' variables. The study will also provide clear-cut directions to small and medium enterprises about how to adopt and implement certain policies to help improve performance through green logistics management practices. This study is the first empirical study conducted in Ghana, which combines all the variables used in this work.

The study is primarily conducted to investigate the connections existing among information technology,

supply chain quality integration, green logistics management and organisational performance. Again, the paper explores the impact of green logistics management on organisational performance. Further, the study assesses the impact of information technology on supply chain quality integration. Therefore, the research answers the questions:

- What relationships exist between chain quality integration, information technology organisational performance and green logistics management?
- Does green logistics management play a mediating role between supply chain quality integration and information technology, and organisational performance?
- Does supply chain quality integration mediate the connection between information technology and organisational performance?

The first part of the paper contains an introduction. The subsequent sections contain literature review and hypothesis development, methodology, data analysis, results and discussions, and finally, the conclusion which contains implications, limitation and future research areas.

Literature Review

Theoretical Background

The paper employs both the stakeholder theory (Freeman, 1984) and the natural resource-based view (NRBV) of the firm (Hart, 1995) to explain the variables.

According to Dierickx & Cool, (1989) and Peteraf, (1993), the resource-based view (RBV) recognises organisations as a set of particular resources, that are put together to develop capabilities to achieve a specific goal. This theory asserts that firms that own and correctly apply heterogeneous, rare, hard-to-imitable, valuable and non-substitutable resources and capabilities can achieve competitive advantage (Barney, 1991, 1996; Conner, 1991).

Resource-based view theory has been subjected to various scrutiny in recent times due to the little relevance it places on the competitive capabilities of environmental factors. Several debates regarding the relevance of internal organisational capabilities to create and sustain competitive advantage have erupted among various scholars (Prahalad & Hamel, 1990; Galbraith & Kazanjian, 1986; Porter 1980, 1990; Peters & Waterman, 1982) due to growing rate of ecological problems and the shift in developing and sustaining competitive capabilities towards environmental factors in recent times.

Prior researchers have discovered that competitive advantage could be achieved by matching both unique firm-centred capabilities and the volatile environmental phenomena (Andrew 1971; Mahoney, 2001; Chandler 1962). The findings of Fiegenbaum et al. (1989) confirm that both internal and external factors are essential for competitive excellence. This resulted in work of Hart (1995) which looked beyond RBV and considered the natural environment which, earlier on, did not receive much attention, as a crucial source of resources and capabilities leading to the creation of the Natural Resource-Based View (NRBV).

Several scholars have used the NRBV to explain green supply chain practices (Vachon & Klassen, 2006, 2008). This theory considers green practices as firms' capabilities, built from a particular set of resources (Flynn et al., 2010; Golicic & Smith, 2013). Hence, green supply chain practices can influence organisational performance leading to sustained competitive advantage (Kirchoff et al., 2016; Vachon & Klassen, 2006; Zhu & Sarkis, 2007).

Scholars who support the stakeholder theory assert that organisations' operations cause external challenges to stakeholders who may often respond by mounting pressure on the firms to allay the adverse effects (Delmas & Toffel, 2004; Sarkis et al., 2011). Companies usually react to the pressure of the stakeholders by building and correctly deploying firm capabilities which are measured as a major influencer of social legitimacy and firm performance (Chiu & Sharfman, 2009; Parmigiani et al., 2011).

The stakeholders comprise regulatory stakeholders, internal primary stakeholders, primary external stakeholders and secondary stakeholders (Buysse & Verbeke, 2003; Wu et al., 2017). Firms stand the chance of meeting the varying green requirements of stakeholders when they employ the appropriate technological systems to help integrate supply chain partners for sharing of information and resources which enhance quality through reduction of waste, pollution and energy.

The results of many studies posit that improvement in organisational performance (market and financial)

emanates from the appropriate configuration of internally designed organisational variables (green logistics practices) with exogenous variables (Burns & Stalker, 1961; Handfield et al., 2015). This is an indication that firms which can integrate with their supply chain members to ensure improvement in the quality of product and services by adhering to green supply chain practices can improve their overall performances. This has led to the development of the conceptual model and hypotheses.

Conceptual Model

The conceptual model shows the relationship between the exogenous variables and the endogenous variables. The arrows connecting the constructs depict the relationship between them.

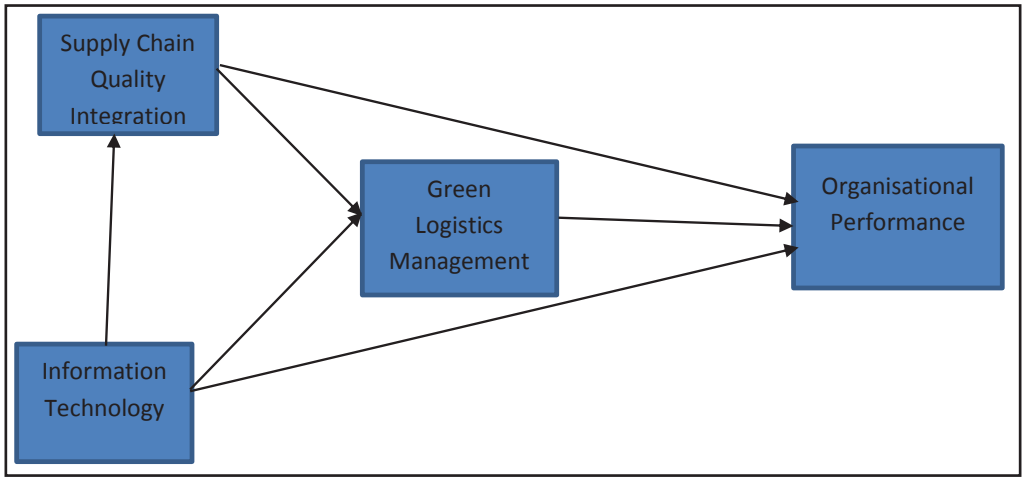

Fig. 1: Conceptual Model

Hypotheses Development

Information Technology and Supply Chain Quality Integration

Information technology involves tools and processes used by firms to help them effectively and efficiently plan, organise, direct and control their activities and processes to enhance firm performance. According to Turek (2013), information technology is the systems that firms use to manage logistics processes and activities (transportation, warehousing and inventory), manufacturing processes, suppliers and customers. According to Franklin (2018), without the use of advanced information technology, it will be impossible for firms to instantaneously establish and effectively manage their current complex global operations.

Several technological systems have been designed and manufactured for running and management of supply chain activities to enhance supply chain performance through information and resources sharing among supply chain partners. These technological tools include enterprise resource planning, transport management system, customer relationship management systems, electronic data interchange, warehouse management systems, radio frequency identification, and tracing and tracking systems (Franklin, 2018; Lyytinen & Damsgaard, 2011; Xuhua 2008). These systems are implemented to ensure that value is added to each activity carried out in each stage of the supply chain to reduce waste and ensure improvement in quality performance.

Since the adoption of supply chain philosophy, information technology has been one of the critical things that have influenced its growth and performance. It is notoriously regarded as an essential factor in supply chain management due to its enormous impact on information exchange among supply chain partners and internal functions of the focal firm (Muller & Gaudig 2011; Newbert 2007; Park 2012). Sharing of information among firms' internal departments, customer and suppliers helps them to make an informed decision regarding the quality of goods and services.

The configuration of quality management practices of a firm with suppliers and customers results in a reduction in defects and wastes (Zhu & Sarkis, 2004; Vachon & Klassen, 2006; Wiengarten & Pagell, 2012; Llach, 2013; Wu et al., 2013). Yu et al. (2017) posit that the operations

of suppliers and customers and supply chain processes affect quality. Hence, many scholars argue that quality management implementation via supply chain integration is the way forward in improving products and processes quality (Huo et al., 2014; Zhang et al., 2017). This shows that supply chain quality integration is a robust approach to solving quality problems.

Nonetheless, organisations' ability to implement effective supply chain quality integration depends on the information gathered, analysed and shared among customers and suppliers by using advanced information technology. Dynamic configuration of quality management practices with firms' suppliers and customers is impossible without the application of advanced information technology. Hence, this is an indication that information technology is a prime driver of supply chain quality integration. Therefore, we develop the hypothesis:

H1: Information Technology Positively Influences Supply Chain Quality Integration.

Information Technology and Green Logistics Management

Externalities created by the operations of organisations and their supply chain partners have caused stakeholders of the environment to demand green and sustainable practices along the supply chain. Green supply chain management involves the integration of eco-friendly concepts or practices into the management of the supply chain which include designing of product, sourcing and selection of material, processes of manufacturing, product delivery to consumers as well as the management of the end-of life of products after their usefulness has been exhausted (Srivastava, 2007).

Green logistics management is the inculcation of sustainable thinking into logistics activities and processes to avoid or reduce the negative impact of supply chain activities and processes on the environment. Green logistics practices could be defined as the internal and external practices of organisation which integrates environmental issues in the supply chain (Bai & Sarkis, 2010; Sarkis et al., 2011).

Going green in logistics involves management of logistics activities such as warehousing, transportation, handling of goods, sourcing, packaging and inventory management to reduce waste, energy usage and impact of pollution on the environment. This show that green logistics management is a section of green supply chain management. Green logistics practices, which include green and returnable packaging, efficient processes and CO_2-efficient transportation, is implemented to reduce environmental impact (Gonzalez-Benito and Gonzalez-Benito 2006; Van Hoek 1999; Sroufe, 2000).

Rao (2019) groups green logistics practices into inbound, internal and outbound green logistics practices. Several scholars consider green or sustainable transportation, sustainable warehousing, sustainable packaging, sustainable reverse logistics and sustainable purchasing as green logistics management practices (Gruchmann 2018; Diabat, & Govindan 2011; Carter and Eastern, 2011; Sarkis, 2003; Carter and Rogers, 2008).

Information technology has been the backbone of green logistics management. Several systems have been developed to manage logistics activities to reduce pollution through the reduction of waste, development of eco-friendly products, recycling of products and reduction in excessive use of energy. The findings of Ahvenniemi et al. (2017) and Gruchman (2018) suggest that the development of green transportation technologies and systems such as electronic data interchange and enterprise resource planning help firms determine their waste disposal orders which lead to reduced waste and energy usage to ensure sustainability.

Enterprise resource planning is used to help firms to plan and manage resources effectively. Advanced technologies are used to make clean fuels such as the liquefied natural gas, hydrogen and electricity used for transportation which is environmentally friendly (Najjar 2013; Klumpp et al., 2013; Thunnissen et al., 2016). This show that information technology influences green logistics management. Hence, we develop the hypothesis:

H2: Information Technology has a Positive Connection with Green Logistics Management.

Information Technology and Organisational Performance

The organisational performance involves the financial and non-financial outcomes of the combined application of business processes, activities, policies and resources. Generally, the performance of an organisation could be measured from the operational, competitive, market,

supply chain management, financial, environmental, reputational, social and quality perspectives (Agyabeng-Mensah et al., 2019; Armistead 1993; Yu et al., 2017; Gunasekaran et al., 2001; Vanichchinchai, 2014; Vanichchinchai & Igel, 2011). However, some scholars have used industry-specific variables such as delivery flexibility, service quality, lead time, agility, legality, leanness and product quality (Vanichchinchai & Igel 2011; Vanichchinchai & Igel, 2009; Chini and Valdez 2003; Kuei et al., 2001).

The performance of an organisation is influenced by several factors. Several scholars posit that firms which take total quality management and supply chain management practices seriously can satisfy the needs of their customers and achieve optimal performance (Gunasekaran et al., 2001; Vanichchinchai, 2014; Vanichchinchai & Igel, 2011). Some scholars also argue that implementing the right policies and procedures that help achieve customer satisfaction leads to improved organisational performance.

Existing research literature about information technology gives varying discoveries about its relationship with organisational performance. According to Cron and Sobol (1983), firms which intensively use computers achieve insignificant performances. The findings of Turner (1985) suggest a significant relationship between information technology and firm performance. Information technology has been identified as one of the critical drivers of organisational performance (Basheer et al., 2019; Neumann & Fink, 2007; Ang et al., 2000).

According to Basheer (2019), information technology capabilities have a significant positive impact on supply chain performance. Basheer et al. (2019) argue that information technology reduces costs and improves operational agility. This further reflects the improvement of the overall performance of firms. The findings of Dehning et al. (2005) suggest that information technology has a positive relationship with market performance.

Numerous researchers posit that firms which increase the application of information technology enhance their market position (Anderson et al., 2001; Bharadwaj et al., 1999; Krishnan and Sriram, 2000) which leads to improved organisational performance. Stratopoulos and Dehning (2000) argue that organisations that use logistics information technology improve upon their profit performance. Hence, we say that:

H3: Information Technology has a Positive Influence on the Performance of an Organisation.

Supply Chain Quality Integration and Green Logistics Management

Several scholarships have explored supply chain integration from various perspectives. Some have considered it from process perspectives (Angeles, 2009; Rai et al., 2006; Rajesh and Matanda, 2019) while others have assessed it from both internal and external perspectives (Agyabeng-Mensah et al., 2019; Rosenzweig et al., 2003; Marquez et al., 2004; Stanley and Wisner 2001; Pagell 2004; Petersen et al., 2005; Narasimhan and Kim 2002; Droge et al., 2004; Campbell and Sankaran 2005; Koufteros et al., 2007; Vickery et al., 2003).

According to Lin (2003) and Yu et al. (2017), supply chain integration can be studied from the quality management perspective. Lin (2013) argue that the most challenging things to achieve in supply chain management are quality and operational efficiency. Yu et al. (2017) suggest that internal processes and supply chain partners of a firm contribute hugely to quality problems. For this problem to be solved, there is the need to include suppliers and customers in the management of quality processes of organisations.

Kuei and Madu (2001) suggest that the concept of quality management has moved from the in-house to include supply chain systems. This has led to the advent of supply chain quality integration. Huo et al. (2014) define supply chain quality integration as the degree to which firms strategically and operationally coordinate and configure internal and external functions with customers and suppliers to join forces to control both internal and external organisational relationships regarding quality, interactions and processes by aiming at achieving excellent quality performance at fewer costs (Huo et al., 2014).

According to Flynn et al. (2010), supply chain quality integration has three dimensions, which include internal, supplier and customer quality integration. Customer and supplier quality integration is the extent to which firm integrates with its customers and suppliers (external partners) to jointly organise procedures, practices and strategies into collective, synchronized quality management processes to meet the quality expectations of

customers. Bowersox et al. (1999) and Huo et al. (2014) assert that supplier quality integration create quality capabilities from collaborations with strategic suppliers, while customer quality integration reconciles firms with their crucial customers.

Firms that align quality management practices with suppliers and customers reduce product defects and resource wastage (Vachon & Klassen, 2006; Wiengarten & Pagell, 2012; Llach et al., 2013; Wu, 2013). Suppliers are motivated by supplier quality integration to provide high-quality eco-friendly goods which meet the quality expectations of customers and help the achievement of environmental objectives (Carter & Carter, 1998; Zhu et al., 2005; Huo et al., 2014).

According to some researchers, supplier quality integration inspires organisations to make green policies and plans that ensure recycling of packages and reduction of solvent emissions to improve green customer cooperation (Vachon & Klassen, 2006; Blome et al., 2014). Customer quality integration positively influences the extent to which firms cooperate with supply chain partners to ensure cleaner production, green packaging and product recycling (Vachon & Klassen, 2006; Zhu & Sarkis, 2007). Thus, we propose the hypothesis:

H4: Supply Chain Quality Integration Positively Influences Green Logistics Management.

Supply Chain Quality Integration and Organisational Performance

Several researchers have discovered a positive relationship between supply chain integration practices. Supply chain quality integration is primarily known to influence environmental performance through the development of a good corporate image. Supply chain quality integration helps firms share information with their suppliers and customers to manage quality processes to reduce waste and excessive energy to reduce cost.

This influences the operational, market and financial performance of firms since goods will be sold at lower prices to customers. Armistead (1993) discovered that the level of supply chain quality integration increases the manufacturing performance of firms, which improves organisational performance through high-quality performance. Prajogo & Hong (2008) suggests that internal, supplier and customer total quality integration are essential drivers of performance.

According to Kuei and Madu (2001), firms improve on their performances when they involve suppliers in their quality management processes. Tracey and Vonderembse (1998) discovered that when integration causes suppliers to improve upon their quality performance on delivery time, firms improve upon their manufacturing performances. The findings of Lin et al. (2005) suggest that supplier quality integration encourages collaboration, which engenders improved organisational performance. Thus, we say that:

H5: Supply Chain Quality Integration has a Positive Relationship with Organisational Performance.

Green Logistics Management and Organisational Performance

There is the general assumption that firms which implement green management practices improve on their performance (Dechant & Altman, 1994). Green logistics management influences the reputational and environmental performance of a firm. Firms which develop and implement green logistics policies meet the customer quality needs by ensuring that resources are efficiently used to reduce waste. This helps firms to develop low-cost competitive advantage, which translates into improved organisational performance. Many scholars assert that green logistics practice increase environmental performance (Carter & Carter, 1998; Yu et al., 2017; Rao & Holt, 2005; Zhu et al., 2013).

According to Rao (2019), currently, green sourcing is a crucial driver of economic performance since customers are enticed with green initiatives. Furthermore, Rao (2019) argue that greening outbound logistic increase the chance of achieving both environmental performance and economic performance. Several scholars have discovered that the economic performance of an organisation especially is a leading contributing factor for the adoption of green initiatives (Rao, 2002; Klassen & McLaughlin, 1996). Therefore, we develop the hypothesis:

H6: Green Logistics Management has a Positive Connection with Organisational Performance.

Information Technology, Supply Chain Quality Integration, Green Logistics Management and Organisational Performance

The agitation for green logistics initiatives has caused firms to look out for factors which enhance green logistics practices and help firms recoup their investments made into those green projects. Information technology used in supply chain management facilities the sharing of information among supply chain partners and a focal firm to make an informed decision about quality management which ensures adherence to green logistics practices resulting in improved environmental, market and overall organisational performances.

Intra- and inter-organisational management of quality demand firms to have the necessary technologies in place to help share quality inclined information and resources to optimise the use of resources through the adoption of sustainable logistics practices so that they could meet the expectations of customers which increases the market and financial performance. Adopting the appropriate information technology that enhances green logistics management practices and quality integration helps firms earn reputation and trustworthiness from the public and causes loss reduction stemming from market risk. This increases firms' competitiveness, causes a reduction in the fears of substitution and improves the market position of the firm, which leads to organisational success. Hence, we hypothesise that:

H7: Supply Chain Quality Integration Mediates the Connection Between Information Technology and Green Logistics Management.

H8: Green Logistics Mediates the Connection Between Information Technology and Organisational Performance.

H9: Green Logistics Management Mediates the Connection Between Supply Chain Quality Integration and Organisational Performance.

H10: Supply Chain Integration and Green Logistics Management Mediate the Relationship Between Information Technology and Organisational Performance.

H11: Supply Chain Quality Integration Mediates the Connection Between Information Technology and Organisational Performance.

Methodology

Sampling and Data Collection

This study uses small and medium enterprises as the unit of analysis. We collected all our data through a mail survey. We randomly selected the firms from the database of Registrars Department of Ghana and business directories. We targeted strategic managers (senior executives, general managers, managing directors) and tactical managers (logistics managers, supply chain managers, quality managers) as our respondents. We chose managers who have more than 10 years of work experience in their respective fields. We made calls to confirm the participation of firms which would be interested in taking part in the survey. We requested for the contact details of potential respondents in the companies we contacted.

The questionnaires were mailed to them along with returning envelopes. A cover letter containing the explanations of the purpose, and the quality of the survey, as well as confidentiality assurance of the data, was added to the mailed questionnaires. We delivered 700 questionnaires and received 327, of which 280 were valid. The valid 280 questionnaires represent 40% effective response rate. The managers at the strategic level represent 81% of the effective response rate, while 92% of them had held their current positions for not less than 4 years. This is an indication that the respondents suit this study. The details of the responding firms and respondents are contained in Tables 1 and 2.

Development of Questionnaires

We followed all the four stages of questionnaire development procedure suggested by (Sudman and Bradburn, 1982; Yan et al., 2015; Creswell 2009) in order to develop appropriate questionnaires. We undertook a preliminary interview with strategic and tactical managers who have in-depth knowledge and rich experience in our area of interest using unstructured, open-ended questions. This gives us fundamental knowledge in the constructs used in the study. We made a draft of the questionnaires following the results of the interview.

Again, we pretested the questionnaires by distributing them to 10 managers and 15 scholars to examine their relevance and clarity. Responses received from the scholars

and the managers guided us to remove unimportant scales and measure items to improve accuracy and suitability. We duly inculcated the suggestions received from each of the managers and the scholars into the final set of the questionnaires.

Measuring Variables

Several relevant studies have designed and used survey instruments that measure information technology, green logistics management, supply chain quality integration and organisational performance. We applied a 7-point Likert-type scale (1 = strongly agree to 7 = strongly disagree). Information technology was measured using enterprise resource planning, transport management systems, warehouse management systems and electronic data interchange (Franklin, 2018; Lyytinen & Damsgaard, 2011; Xuhua 2018).

We measured information technology with eight measuring items. We operationalised supply chain quality integration as internal quality integration, customer quality integration and supplier quality integration (Flynn et al., 2010; Huo et al., 2014; Yu et al., 2017). Six measuring items were used to measure supply chain quality integration. Green logistics management was measured using green/sustainable transport, green/sustainable warehousing and green/sustainable packaging (Carter and Jennings 2002; Ciliberti et al., 2008). Six items were used to measure this construct. We used six items to measure green logistics management. The organisational performance was operationalised through quality performance, environmental performance, financial performance and market performance (Zhu & Sarkis, 2004; Agyabeng-Mensah et al., 2019; Rao 2019). Eight measuring items were used to measure it.

Non-Response Bias and Common Method Bias

Our study is vulnerable to response bias and common method bias like any other survey oriented research. We tested the non-response bias of early 188 samples and the late 92 samples using T-test as recommended by Armstrong and Overton (1977). We discovered that there is no substantive variance in information technology, supply chain quality integration, green logistics management and organisational performance. The responses of these two samples did not significantly differ at the 5% significance level.

Common method bias was evaluated using collinearity Statistics (VIF) suggested by (Kock 2015). We found that there was a little bias between the green logistics management and organisational performance since those variables have inner VIF value of 4.07, which is above the threshold 3.3 recommended by Kock (2015). However, common method bias should not be a worry in this study. Table 4 contains the values for the VIF.

Table 1: Profile of Responding Companies

Industry	Quantity	Percentage (%)
Textiles Factory	20	7.14
Food, Beverage and Alcohol	70	25
Shoe Manufacturers	32	11.42
Spare Parts	40	14.29
Super Markets	45	16.07
Fuel Selling Companies	12	4.28
Distributors	25	8.93
Wholesalers	18	6.43
Logistics firms	18	6.43
Age (Years)		
1–5	68	24.29
6–10	82	29.29
11–15	52	18.57
16–20	30	10.71
Above 20		17.14
Number of Employees		
1–19	105	37.50
20–39	41	14.64
40–59	40	14.29
60–79	65	23.21
80–99	29	10.36

Table 2: Details of Respondents

Position	Percentage (%) of Respondents	Work Experience In Years	Percentage (%) of Respondents
Strategic Manager	59.21	10–20	67.72
Tactical Manager	41.79	5–9	32.28

Table 3: Inner VIF

Construct	Green Logistics Management	Organisational Performance	Supply Chain Quality Integration
Green Logistics Management		4.074	
Information Technology	1.415	1.797	1.000
Supply Chain Quality Integration	1.415	3.210	

Data Analysis, Results and Discussion

Analysis

This study applied partial least squares path structural equation modelling (PLS-SEM) to assess the conceptual model. We employed SmartPLS-3 to analyse the survey data we collected through questionnaires **(**Ringle et al., 2015**)**. We chose SmartPLS-3 because it is the most appropriate tool used to do analysis in social sciences (Hair et al. 2014; Naway & Rahmat, 2018). SmartPLS-3 is a technique that allows researchers to assess the validity of prediction of the independent variable on the dependent variable (Peng and Lai, 2012; Dubey 2018).

Several scholars argue that SmartPLS removes several challenges (inadmissible solutions and factor indeterminacy) and it is an appropriate technique for providing comprehensive explanation for an existing complex connections between variables (Henseler et al., 2014; Moshtari, 2016; Akter et al., 2017; Martí-Ballester & Simon, 2017; Dubey et al., 2018). It is also appropriate for testing the validity of the hypotheses.

It is an analysis tool that assesses the model by examining the validity and reliability of the latent variables (Hair et al., 1998). Rodgers and Pavlou (2003) essentially suggest the removal of low-value items. That is, we removed all indicators that could not meet the threshold of 0.70. Again, we trimmed the model to enhance the AVEs and improve on the strength of the direct connections between the constructs (Rodgers and Pavlou 2003). We ran the algorithm and the bootstrapping several times to obtain the desired results.

The analysis of this paper is put into two parts. We first analyse the outer model, which comprises the construct reliability, validity and discriminant validity. We analyse the construct reliability and validity of the constructs using Cronbach's Alpha, composite reliability and average variance extracted (AVEs). We then analyse the discriminant validity by using factor loadings, Heterotrait-Monotrait Ratio (HTMT) and Fornell-Larcker criteria. The second part of the work analyses the inner model. That is, we examine the relationship between the endogenous and the endogenous variables. This is achieved through hypotheses testing (Hameed et al., 2017; Agyabeng-Mensah et al., 2019).

Table 4: Measurement Criteria Thresholds

Measurement Criteria	Recommended Threshold
Factor loading (Hair et al., 1998)	≥ 0.70
Composite reliability (Bagozzi and Yi, 1988)	≥ 0.60
Average Variance Extracted (Rodgers and Pavlou, 2003)	>0.50
Cronbach's Alpha (Henseler et al., 2009)	≥ 0.70
HTMT Ratio (Hair et al., 1998)	<0.85
P value	<0.05
Inner VIF (Kock, 2015)	≤3.3

Source: Adapted from Hair et al. (1998), Henseler et al. (2009), and Rodgers and Pavlou (2003)

Assessment of Inner Model

The inner model is examined using the discriminant validity and construct reliability and validity. The values for the Cronbach's Alpha, composite reliability and average variance extracted (AVEs) that are used to examine the construct reliability and validity are all valid since they meet the thresholds 0.70, 0.60 and 0.50, respectively, as recommended by scholars. This is shown in Table 5. This shows that the constructs used for this model are reliable and valid.

Furthermore, the discriminant validities of the constructs were assessed using factor loadings, Heterotrait-Monotrait Ratio (HTMT) and Fornell-Larcker criteria. All the values of the factor loadings of the indicators were above 0.70 and HTMT less than 0.85, which are suggested by the literature. The measurement of discriminant validity using the AVE was recommended by Fornell-Larcker (Samander et al., 2017). Tables 6, 7, and 8 contain the values used to assess the discriminant validity of the constructs.

Table 5: Construct Reliability and Validity

	Cronbach's Alpha	Rho_A	Composite Reliability	Average Variance Extracted (Ave)
Green Logistics Management	0.809	0.935	0.887	0.724
Information Technology	0.822	0.826	0.882	0.652
Organisational Performance	0.819	0.821	0.881	0..651
Supply Chain Quality Integration	0.899	1.155	0.925	0.803

Table 6: Fornell-Larcker Criteria

Construct	Green Logistics Management	Information Technology	Organisational Performance	Supply Chain Quality Integration
Green Logistics Management	0.851			
Information Technology	0.666	0.807		
Organisational Performance	0.657	0.597	0.807	
Supply Chain Quality Integration	0.830	0.541	0.618	0.896

Table 7: Heterotrait-Monotrait Ratio (HTMT)

Construct	Green Logistics Management	Information Technology	Organisational Performance
Information Technology	0.780		
Organisational Performance	0.752	0.709	
Supply Chain Quality Integration	0.801	0.486	0.603

Table 8: Factor Loadings

	Green Logistics Management	Information Technology	Organisational Performance	Supply Chain Quality Integration
GLM1	0.955			
GLM3	0.763			
GLM6	0.824			
IT1		0.779		
IT2		0.835		
IT5		0.779		
IT7		0.835		
OP1			0.863	
OP2			0.786	
OP5			0.863	
OP7			0.706	
SCQI1				0.912
SCQI2				0.889
SCQI5				0.889

Assessment of Inner Model

After the outer model has been examined to confirm the reliability and the validity of the variables, we further moved to examine the inner model through testing of the hypotheses (Hameed et al., 2017, Agyabeng-Mensah et al., 2019). We discovered that all the P-values of the hypotheses are below the confidence level of 0.05 as shown in Tables 9 and 10. This shows that all the hypotheses are supported and accepted. This part examines the relationship between the endogenous variables and the exogenous variables. It assesses both the direct and indirect connection between information technology, supply chain quality integration, green logistics management and organisation performance.

We discovered that there are positive relationships between the independent and dependent variables. Information technology has a positive relationship with supply chain quality integration, green logistics management and organisational performance. Again, we found that supply chain quality integration has a positive influence on organisational performance and green logistics management. Subsequently, we discovered a positive relationship between green logistics management and organisational performance.

Table 9: Direct Effect

Construct	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Hypothesis
Green Logistics Management -> Organisational Performance	0.260	0.255	0.097	2.683	0.007	H:6 Supported
Information Technology -> Green Logistics Management	0.306	0.307	0.032	9.535	0.000	H2: Supported
Information Technology -> Organisational Performance	0.291	0.298	0.064	4.528	0.000	H3: Supported
Information Technology -> Supply Chain Quality Integration	0.541	0.546	0.035	15.441	0.000	H1: Supported
Supply Chain Quality Integration -> Green Logistics Management	0.664	0.663	0.028	23.435	0.000	H4: Supported
Supply Chain Quality Integration -> Organisational Performance	0.244	0.246	0.078	3.133	0.002	H5: Supported

After testing the direct connection and impact between the independent constructs and the dependent constructs, we further assess the indirect relationship among them. We found that supply chain quality integration positively mediates the connection between information technology and green logistics management. This is an indication that supply chain quality integration improves the impact of information technology on green logistics management. It is further discovered that green logistics mediates the connection between information technology and organisational performance. This shows that information technology better influences organisational performance when green logistics management practices are adopted.

Again, green logistics management serves as a positive intermediary between supply chain quality integration and organisational performance. The adoption of green logistics practices enhances the benefit of using information technology to improve the performances of firms. Besides, the results of this study have established that supply chain quality integration has a significant positive mediating effect between information technology and organisational performance.

Finally, the adoption of supply chain quality integration and green logistics management increases the positive impact of information technology on the performance of

an organisation. Thus, supply chain quality integration and green logistics management positively mediate the relationship between organisational performance and information technology. This shows that organisations that seek to reap the benefit of the adoption of information technology should also adopt green logistics management practices and supply chain quality integration to enhance performance.

Table 10: Indirect Effect

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values	Hypothesis
Information Technology -> Supply Chain Quality Integration -> Green Logistics Management	0.359	0.361	0.016	22.383	0.000	H7: Supported
Information Technology -> Green Logistics Management -> Organisational Performance	0.080	0.077	0.028	2.814	0.005	H8: Supported
Supply Chain Quality Integration -> Green Logistics Management -> Organisational Performance	0.173	0.170	0.065	2.650	0.008	H9: Supported
Information Technology -> Supply Chain Quality Integration -> Green Logistics Management -> Organisational Performance	0.094	0.093	0.037	2.515	0.012	H10: Supported
Information Technology -> Supply Chain Quality Integration -> Organisational Performance	0.132	0.133	0.040	3.272	0.001	H11: Supported

We further explore the impact level of impact of the exogenous variables on endogenous variables in the model by using the variance explained. It is discovered that information technology predicts 29.30% of supply chain quality integration. Combination of supply chain quality integration and information technology predicts green logistics management by 75.50%. Supply chain quality integration, information technology and green logistics management collectively explain 49.6% of organisational performance.

This shows that information technology has a moderate effect on supply quality integration while information technology combined with supply chain quality integration have a substantial predicting effect on green logistics management. The combination of information technology, supply chain quality integration and green logistics management has moderate predicting effect on organisational performance. This is shown in Table 11.

Table 11: Variance Explained

Construct	R Square
Green Logistics Management	0.755
Organisational Performance	0.496
Supply Chain Quality Integration	0.293

CONCLUSION

The paper primarily seeks to establish the relationship between information technology, supply chain quality integration, green logistics management and performance in the small and medium enterprises. We analysed the survey data collected from the 280 strategic and tactical managers through questionnaires using SmartPLS-3. The hypotheses tested were all supported and accepted. This means that there are positive relationships between information technology, supply chain quality integration, green logistics management and organisational performance.

We further discovered that supply chain quality integration and green logistics management significantly mediate information technology and organisational performance. Finally, it was found that the combination of supply chain integration, green logistics management and information technology have a moderate effect on performance, while the collective effect of information technology and supply chain quality integration on green logistics practices is substantive. Moreover, information technology has a moderate effect on supply chain quality integration.

The findings of this study contribute to the literature by confirming the positive relationship between supply chain quality integration and organisational performance (Basheer et al., 2019; Dubey 2019; Zhang et al., 2011; Neumann & Fink, 2007; Ang et al., 2000). Moreover, the findings of this study confirm the positive relationship between green logistics management and organisational performance as already established by many scholars (Carter & Carter, 1998; Yu et al., 2017; Rao & Holt, 2005; Zhu et al., 2005; Zhu et al., 2013).

Besides, we found that supply chain quality integration and information technology influence green logistics management practices. Moreover, we explored and established a positive and significant combined effect of information technology, green logistics management and supply chain quality integration on firm performance. Investigating and discovering the significant mediating roles played by supply chain quality integration and green logistics management between information technology and organisational performance is an excellent contribution to scholarship in this discipline.

According to the results of this study, supply chain quality integration positively mediates the connection between information technology and green logistics management. This shows that the adoption and application of supply chain quality integration increase the influence of information technology on green logistics management. This is a call on managers to adopt information technology and supply chain quality integration to enhance effective implementation of green logistics practices. Moreover, green logistics management has now become a necessary competitive tool that positive influences organisational performance.

Firms must ensure that green logistics practices are adopted and effectively implemented to safeguard the environment and increase organisational performance. This will be achieved if appropriate information technology tools and systems are adopted to facilitate the integration of quality management practices with customers and suppliers. This study advices managers to adopt green practices, information technology, supply chain quality integration to increase their financial, market, quality and environmental performances.

This study has limitations which give room for future studies. The results of this cannot be generalised. Hence, the conceptual model tested can be replicated in other industries and locations. Again, further research can be conducted to explore the effect of implementing this model on the performance of the competitors of a focal firm.

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