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The challenges of green logistics in the Durban road freight industry

Abstract

In order to ensure sustainability within supply chain networks, organisations are being placed under constant pressure to approach their business operations in accordance with the concept of the triple bottom line. Many firms are beginning to adopt green practices to promote the integration of social, environmental and economic considerations. As dependency increases between global economies, businesses and countries, enhanced collaboration will ensure the successful implementation of green initiatives. Forging a harmonious balance between the environment, economy and society will ensure the sustenance and future of supply chains worldwide. The purpose of this study is to understand the challenges of greening logistical operations and activities in the road freight industry. The study further uses multiple regression to evaluates the relationship between logistical operations and the effects of green supply chain diffusion initiatives on 160 respondents. Although it is difficult to establish the association between the adoption of green supply chain initiatives and genuine environmental consciousness, as well as business-based and ethically-based initiatives, the study reveals that company policies encourage the greening diffusion of logistical activities. In terms of managerial implications, companies should acknowledge the influence of green knowledge and information awareness aligned with positive performance targets to alleviate green logistical costs and to reduce routing schedules.

Keywords: green supply chain diffusion, green logistics, environmental management system, information systems.
JEL Classification: L91, Q51, Q52.

Introduction

As globalization increasingly integrates communities and countries, the environment becomes severely exposed to negative externalities that threaten a constant supply of natural resources. Heightened awareness of the environmental issues that threaten economic sustainability will make the public more vigilant with regards to their purchasing behavior and consumption activities. Business processes, policies and activities that threaten the environment will come under scrutiny and companies, state-owned enterprises and other organizations will face increased pressure in the 21st century. The recent world economic crisis highlights the need for sustainability plans that seek to protect and preserve scarce resources, creating potential for a greener economy. Organizations will need to implement sustainable (green) logistics and green supply chain management (GSCM) practices in order to address environmental challenges.

Background

Supply chain management can be viewed as a component of business logistics. Business logistics is described by Pienaar and Vogt (2009, p. 6) as, "the inbound movement of materials and supplies, and the outward movement of finished products. Its goal is the delivery of the finished products required by the marketing department to the point where they are needed, when they are needed, in the most economical fashion." Simchi-Levi, Kaminsky, Simchi-Levi, (2008, p. 1) define supply chain management (SCM) as "a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses and stores, so that merchandize is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements." The Chartered Institute of Purchasing and Supply (CIPS) (2012) describes Supply Chain Management as "all those processes associated with management of the flow of goods, information and money between suppliers in a category's supply chain. The concept of 'flow' refers to the common objective of reducing waste in the supply chain. The dialogue between supply chain participants usually involves sharing information and may result in less opportunism and better relationships" (CIPS, 2012).

The epitome of all supply chains is logistics and transportation activities. There is an important distinction between the two terms. Whilst the Business Dictionary (2012) considers transportation the movement of people and goods from one location to another, the Logistics and Supply Chain Management Society (2012) defines logistics as "the organization, planning, control and execution of the goods flow from development and purchasing, through production and distribution, to the final customer in order to satisfy the requirements of the market at minimum costs and capital use". Pienaar and Vogt (2009, p. 9) identify logistics management as "a science concerned with the efficient flow of goods, in its various forms such as raw materials, work in progress or finished goods, from supplier to customer". Logistics and supply chain management contribute greatly to the economy as markets continue to be driven by the forces of supply and demand. Hence, Tseng, Yue and Taylor, (2005, p. 1657) state that "due to the trend of nationalisation and globalization in recent decades,

the importance of logistics management has been growing in various areas." As economies continue to integrate so, too, will transportation and logistics systems,with complex effects on the physical environment. Logistics operators in the Durban road freight industry are susceptible to conformance targets and policies that advocate green methods. There is a need for road freight operators to examine the extent to which logistics activities impact the environment and surrounding societal structures.

Despite the significant role that logistics companies play in the entire value chain, there is a paucity of research on logistics providers and environmental issues (Evangelista, Sweeney, Ferruzzi and Carrasco, 2010). This study explores the range of initiatives companies are implementing to reduce the environmental impact of their transport and logistical activities. In terms of the green logistics challenges faced by logistics companies operating in the Durban region, it is imperative to understand the relationship between the logistical road freight operations and the impetus effect of green supply chain management initiatives to overcome the challenges of green logistics. The migration to green supply chain management will help to address the pernicious effect of environmental damage. More specifically, the study has the following objectives:

1. To understand the challenges of greening logistical operations and activities in the road freight industry.
2. To assess the magnitude of collaboration amongst the trading supply chain partners in implementing green supply chain management initiatives and its relation with logistical road freight operations.
3. To evaluate the relationship between logistical road operations and the effect of green supply chain management.

South African logistics sector perspective

According to the Council for Scientific and Industrial Research (CSIR) in conjunction with Imperial Logistics, South Africa contributes 1% to global annual carbon dioxide emissions (CSIR, 2012). In his 2008 briefing, the Minister of Environmental Affairs and Tourism (Mr. M. Schalkwyk) said "It is clear that without constraints our emissions might quadruple by 2050. This is, in the most literal sense, not sustainable: If we continue with business-as-usual, we will go out of business. The alternative is a very challenging scenario – to make it our goal to achieve what is required by science of a developing country." The report highlights that for the South African economy to reduce its green house gas (GHG) emissions, a coherent vision is required in three areas: policy, investment and technology (SA Government Information, 2008). Policy frameworks need to provide guidance to the country and send appropriate messages to markets. There is a need for greater deployment of existing eco-friendly technologies, together with increased investment in large scale R&D on new technologies. Transportation and logistics are responsible for approximately 75% of South Africa's carbon footprint (Schoeman and Sanchez, 2009). This places the onus on supply chains to accept responsibility, invest and take the required measures towards a green supply chain. Transport accounts for 13% of GHG emissions while the logistics industry contributes 19% to GHG emissions (CSIR, 2012). For South Africa to meet the "required by science" targets – that is, reducing annual emissions by 1300 Metric Ton (Mt) carbon dioxide (CO_2) equivalents (e) per year by 2050 – its transport sector will need to undergo radical transformation. The government's Energy Efficiency Strategy of 2005 set energy reduction targets for the transportation sector; transport operators are required to reduce their energy consumption by 9% by 2015 (SA Government Information, 2008). The transport sector accounts for a higherlevel of carbon emissions than any other sector. According to Fischer (2011) "the transport sector possesses the most complex challenges, because it encompasses fuels, vehicle technology, infrastructure, as well as behavioral changes. Bio fuels alone cannot solve the problem." Bio fuels are liquid fuels derived from waste and animal matter (BAA, 2010).

Hence, the CSIR (2012) study suggests that, "an overall package needs to be designed, that addresses a range of interventions in the sector by acknowledging re-engineering of supply chains towards genuine green initiatives investment, cost reductions, improved efficiencies, corporate social responsibility, and brand reputation enhancement by competing on differentiation". Previous research primarily focused on the United Kingdom (UK) and United States (US) both of whichare first world economies with strong economic standing. South Africa is classified as an emerging economy and has a very different economic standing. It can thus be deduced that the adoption of green initiatives will vary based on the geographic location of the firm and thus economic conditions, market forces and pressures from supply chain partners.

The Supply Chain Foresight Report (2011) survey focused on evolving strategies and supply chain competitiveness in emerging economies. By shifting the focus to supply chain strategies, green supply chains become the order of the day, tasking organizations to deal directly with issues relating to corporate social responsibility (CSR) and sustainability. The survey revealed the following about green supply chains in South Africa:

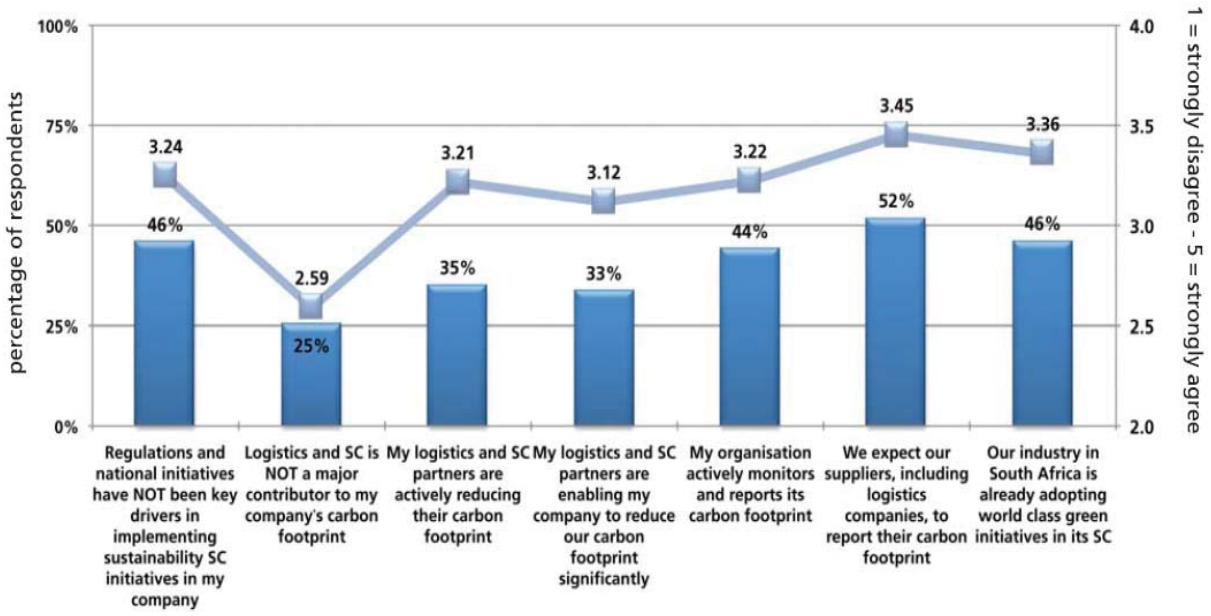

Fig. 1. The green supply chain

Source: Supply Chain Foresight Report. (2011) *2011 Supply Chain Foresight Report*, [online], available: http://www.barloworld-logistics.com/industry-insight/ [September 23, 2012].

A large proportion of the companies surveyed expect suppliers and logistics providers to report their carbon footprint (52%); this demonstrates that South Africa is adopting world class green initiatives in its supply chain.

Green supply chain management and logistics

The Council for Supply Chain Management Professionals (CSCMP) (2012) defines supply chain management as "the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities". Hence green can be adopted and understood in the context of supply chain management. Penfield (2007, p. 18) defines green supply chain management (GSCM) as "the process of using environmentally friendly inputs and transforming these inputs through change agents – whose by-products can improve or be recycled within the existing environment. This process develops outputs that can be reclaimed and re-used at the end of their life-cycle thus, creating a sustainable supply chain." According to Srivastara (2007, p. 54) GSCM involves "integrating environmental thinking into supply-chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers as well as end-of-life management of the product after its useful life." Similarly Zhu, Sarkis, Cordeiro and Lai (2008), and Chiou, Chan, Lettice and Chung (2011), describe GSCM as the incorporation of "environmental considerations into decision making at each stage of an organization's materials management and logistics functions through post-consumer disposal." Hence, greenness has become a code name for a range of environmental considerations; when 'green' and 'logistics' are joined, they suggest a transport and distribution system that is both environmentally friendly and efficient. Thus, Rodrigue and Slack (2001) define green logistics as "supply chain management practices and strategies that reduce the environmental and energy footprint of freight distribution. It focuses on material handling, waste management, packaging and transport."

Thiell (2010) describes green logistics as "a set of activities related to the eco-efficient management of the forward and reverse flow flows of products and information between the point of origin and the point of consumption whose purpose is to meet or exceed customer demand". If logistics supply chains is the one of the highest contributors to the carbon footprint of most goods, whereby Eyefortransport (2008) claims that 75% of companies' carbon footprint is generated through supply chain related activities. Therefore, making logistics sustainable in the future suggests the need to identify innovative measures which go beyond merely reducing carbon emissions.

Turning to sustainability, the Environmental Protection Agency (2012) states that, "sustainability is based on a simple principle. Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in produc-

tive harmony that permits fulfilling the social, economic and other requirements of present and future generations." In business, sustainability means managing the triple bottom line by focusing on performance along the interrelated dimensions of profits, people and the planet (Lexicon, 2012). Hence sustainable logistics which is also referred to as green logistics is concerned with the reduction of the negative environmental impacts linked with the movement of supplies and resources between locations and those activities that comprise the logistics function.Supply chain greening is an ever growing concern for businesses worldwide and a challenge for logistics management in the 21st century. Studies that discuss the various green initiatives undertaken in the logistics industry include those by Huge-Brodin, Evangelista, Isaksson and Sweeney (2010), Geroliminis and Daganzo (2010) and Evangelista et al. (2010). The following green initiatives form the underlying themes for discussion in this study.

Environmental management and packaging systems

The Environmental Management System (EMS) is a structured framework that co-ordinates the management and assessment of an organisation's environmental impact such asthe management of waste and carbon emissions. Mollenkopf, Stolze, Tate and Ueltschy, (2010) take this one step further and introduce the dimension of organisational performance, explaining thatan EMS helps a company achieve its environmental goals through heightened operational control. Environmental systems allow a company to measure, manage and control the externalities resulting from its activitiesin order to increase the organisation's environmental logistical performance (Zuo and Li, 2009; Mollenkopf et al., 2010). According to Pienaar and Vogt (2009, p. 432), meeting the requirements set in the standards will enable the organization to, firstly, control the potential environmental impact of its activities and products and secondly, the continuous improvement of environmental performance. Thirdly, it provides a systematic approach for setting targeted environmental objectives. Finally, it allows the organisation to evaluate the degree to which the targets have been met (Pienaar and Vogt, 2009).

Turning to the inconsistencies between logistics and greening (Geroliminis and Daganzo, 2010, p. 4), cost-saving strategies implemented by supply chain logistical parties are often at variance with the environment as the environmental costs are usually externalized. Geroliminis and Daganzo (2010), further states that, "logistical activities do not pay the full costs of using the logistical infrastructure, thus, operators choose the most polluting, least energy efficient and most infrastructure – intensive transportation to increase the speed of distribution." A reduction in packaging can significantly reduce carbon emissions across the supply chain with increased cost savings. Green packaging includes packaging design that takes the environment into consideration. The design of the product also contributes toits impact on the environment during the different stages of the product's life cycle.

According to Lewis and Fitzpatrick, (2007) the packaging industry has been placed under severe pressure to reduce packaging waste and formulate designs that improve recyclability. However, many businesses are concerned that by pursuing these goals, the complex role of packaging in supply chains is compromised. Packaging techniques that use recyclable or biodegradable materials are growing in popularity. The Business Dictionary (2012) defines recyclable material as "raw or processed materials that can be recovered from waste streams or reused" whereas Bianucci (2011) describes biodegradable materials as products that can be broken down through biological means (by fungi, bacteria and simple organisms) without the involvement of unnatural processes. Lewis and Fitzpatrick (2007) affirms that in an ideal world, packaging systems should seamlessly fulfil the expectations of all stakeholders involved in the supply chain as well as government and community stakeholders. They should be able to support business growth, meet user/consumer values and expectations (both in terms of supplying the expected quality of product as well as convenience in product use and discarding of packaging) and have a minimal impact on the environment through supply chain optimization within the triple bottom line framework.

Information technology plays a substantial role in organizations adopting green initiatives by ensuring the achievement of the company's goals through supply chain optimization, green supply chain realization, green supply chain collaboration and the triple bottom line.

The Supply Chain Foresight report (2011, p. 11) observes that, "sustainability and governance is not only about carbon emission reduction and environmental awareness." It adds that businesses need to become more sustainable by creating an appropriate environment to monitor and mitigate risk. An appropriate control system can ensure business success and profitability in a way that sustains societies.

Methodology

Type of design. Cooper and Schindler (2008, p. 143) describe exploratory studies as "loose structures with the objective of discovering future re-

search tasks." Sampling design is defined as the process of selecting the number of units for a study in a way that represents the larger population from which they are selected (Sekaran and Bougie, 2010, p. 266). Castillo (2009) defines the target population as "the entire group of individuals or objects to which researchers are interested in generalizing the conclusions. The target population usually has varying characteristics and it is also known as the theoretical population." This study is divided into two parts; firstly, the research is based on the literature review summarised in the previous section, which was instrumental in designing the data collection guide. Secondly, the data collection phase involved the participation of a set of logistics service providers in the Durban region, South Africa. The empirical analysis explored a number of key issues concerning third party logistics' (3PLs) supply chain green offerings and the associated challenges of green implementation.

A cross-sectional, self-administered survey in the Durban region, KwaZulu-Natal, South Africa was used for data collection on the targetsample frame of logistics companies. The target population for this study was logistics companies in the Durban region, namely, employees occupying managerial positions at all three managerial levels (lower, middle and top level management) along with those in non-managerial positions such as supervisors. These departments are categorised as transport, warehousing or other divisions such as Safety; Health; Environment and Quality (SHEQ), Risk Management, Human Resources (HR) and Finance. The researcher employed the stratified random sampling method as part of probability sampling. This method of sampling design involves the division of a population into smaller groups known as strata (McBurney and White, 2004, p. 251). The population is broken down into various types of positions held among the different departments. Disproportionate samples were gathered from the stratum and pooled to form a sample. Due to the subject under investigation, an important aspect of this research is examining the extent to which the concept of green logistics has been communicated along the organisational structure. Hence, the researcher chose to administer questionnaires to employees that represent the various divisions in logistics companies.

The sample of 160 respondents was drawn from the target population. The measuring instrument in this empirical study commenced with basic biographical and general perceptions questions. Eventually it utilized five-point Likert scale where respondents (supervisors and managers) expressed their levels of agreement or disagreement regarding their perceptions on green initiative diffusion. The questionnaires were delivered to the respondents and a total of 160 out of 200 distributed questionnaires constituted a return rate of 80%. All responses were carefully scrutinized for completeness, consistency and errors, and to eliminate questionable data.

Data collection and measurement instruments

Questionnaire. The questionnaire was composed of four sections. Section A focused on collating biographical information from the respondent and the company. Section B of the questionnaire aimed to elicit concise information on the subject under investigation. These questions solicited 'yes' or 'no' answers and were designed around green initiatives, information awareness, technology, corporate policies and legislation. The third section (section C) involved a more interactive approach. The respondents were required to rank given statements according to their perceptions and experience of working in the organisation. In section C, respondents were required to choose five barriers and five drivers from the options provided and rank each question in order of importance from 1-5, with 1 indicating 'least important' and 5 indicating 'most important'. The fourth segment (section D) was based on the 1-5 point likert scale, where respondents were asked to rate the statements in accordance to what they perceived to be true. Respondents could either agree, disagree, or choose to be neutral when rating each statement. This section also provided important data that will be used in conjunction with the other three sections when the researcher is analysisng the results.

Data analysis. Data analysis is the most crucial aspect in this research. Once the researcher had gathered the necessary information from the sample, statistical analysis was conducted to confirm the objectives that were set out in the theoretical framework. Statistical analysis was performed using two types of software, SPSS and Excel. The analysis techniques include univariate data analysis (descriptive statistics), bivariate data analysis (cross-tabulation and ANOVA), and multivariate data analysis (multiple regression).

Table 1. Testing hypotheses on pearson chi-squared, ANOVA and multiple regression

Set one and two: Pearson Chi-squared tests				
Cross-tabulate		Pearson (χ^2) (value)	DF	Sig.
Customer-supplier pressure	Renewable energy	3.396[a]	1.4	0.494
	Packaging reduction	2.817[a]	1.4	0.589

Table 1 (cont.). Testing hypotheses on pearson chi-squared, ANOVA and multiple regression

Set one and two: Pearson Chi-squared tests				
Cross-tabulate		Pearson (χ^2) (value)	DF	Sig.
Green initiative diffusion	Green knowledge & information	9.867	4.1	0.043
	Organisation performance targets	11.099	4.1	0.025
Set three: ANOVA				
	ANOVA	Homogeneity-Lenene	Robust test-Sig.	
Company's strategy on sustainability	B = 11.594; W = 96.974; F = 4.065; Sig. = 0.004	Levene-stat = .808; Sig. = .522; Df = 4.136	Welch = .033	Brown-Forsyth = .045
Transportation of environmentally friendly goods	B = 13.284; W = 109.116; F = 4.718; Df = 4.155; Sig. = 0.001	Levene-stat = 4.636; Sig = 0.001; Df = 4.155	Welch = 0.041	Brown-Forsyth = 0.043
Green logistics costs	B = 42.442; W = 79.958; F = 20.569; Df = 4.155; Sig. = 0.000	Levene-stat = 4.514; Sig = 0.002; Df = 4.155	Welch = 0.000	Brown-Forsyth = 0.006

Set four: multiple regression		
Dependent variable – green initiative diffusion	Model 1	Model 2
Constant	2.104 (0.000)	1.459 (0.000)
Green logistical costs	Beta = 0.585 (0.000)	Beta = 0.509 (0.000)
Routing Schedules		Beta = 0.234 (0.000)
R	0.585	0.626
R^2	0.343	0.392
Adjusted R^2	0.338	0.384
F	81.787 (0.000)	50.186 (0.000)
Df	1;157	2; 156
Collinearity statistics	Tolerance = 1.000 VIF = 1.000	Tolerance = 0.894 VIF = 1.118
Durbin-Watson value		1.673
Cronbach's Alpha (13 items)	0.661	

B = Between groups; W = Within groups; Df = Degrees of freedom; Sig. = Significance *level; F = F*-value

Hypothesis set one:

H_{1A}: The green supply chain initiative diffusion on renewable energy and packaging reduction is associated with customer-supplier pressure.

H_{1B}: The green supply chain initiative diffusion on the effect of company size relates to the perceived pressure from customers and suppliers.

Statistically, there is no evidence that renewable energy ($p = 0.494 > 0.05$) and packaging reduction ($p = 0.589 > 0.05$) initiatives are related to aperceived lack of interest from customers and suppliers. There is no strong evidence to pin any green supply chain initiatives on perceived customer-supplier pressure.

Hypothesis set two:

H_{2A}: The propensity to adopt green initiatives relates to green knowledge and information awareness.

H_{2B}: The propensity to adopt green initiatives relates to organisation performance targets.

This set of hypotheses seeks to understand the influence of the magnitude of green knowledge and information awareness and the association of supply chain organization performance targets with supply chain green initiatives diffusion. The Pearson Chi-squared tests reveal that the magnitude of green knowledge and information visibility on green initiatives awareness ($\chi^2 = 9.867$; Df = 4.1; $p = 0.043 < 0.05$) is associated with positive influence to successfully adopt green supply chain initiatives. In the conjoint agreement (144 out of 160 respondents), the test discloses ($\chi^2 = 11.099$; Df = 4.1; $p = 0.025 < 0.05$) that the adoption of green initiatives does have an association with the positive performance targets set by the organisation.

Hypothesis set three:

H_{3A}: The variation to green initiative adoption relates to reformed company strategy on sustainability.

H_{3B}: The variation to green initiative adoption relates to the optional transportation of environmentally-friendly goods.

H_{3C}: The variation to green initiative adoption relates to the effect on green logistical costs.

ANOVA are statistical tests which compare the means of groups in order to analyze whether the

differences across the means are reliable (Beins and McCarthy, 2012, p. 204). ANOVA looks at the differences within the group and among the group, but there is no way of telling where the differences lies whilst also indicating the significance levels among the variables (Pallant, 2009). The Levene's test indicates the p-value = 0.522 > 0.05 without violating the assumption of homogeneity of variance, while Welch and Brown-Forsyth significance values confirm homogeneity among the groups 0.033 and 0.045, respectively, thus show significant differences between the groups without ANOVA. The ANOVA gives both between groups (11.594) and within groups (96.974) sums of squares, with degree of freedom (4; 136) and significance value (0.004) less than 0.05. The majority (61.3%) of the respondents identify strategic sustainability as the third most important driver of green initiatives after decisions on environmental protection (71.9%) and conformance with environmental legislation and regulation (70%). As supply chain business-driven decisions reflect the lower-ranked drivers such as green supply chain benefits on increased business performance targets and delivery efficiency (55%) and pressure from suppliers and customers (51.9%), the company strategy on sustainability (as the strategy advocates both environmental- and business-driven) significantly depicts the difference somewhere among the mean scores on green supply chain initiative diffusion.

If environmental protection, and legislation and regulation are highly ranked number one and two consecutively in supply chain greening initiatives, it would be interesting to understand whether the organisation does business with customers who transport environmentally-friendly goods. Table 1 indicates the violation of assumption with Levene value 0.001 < 0.05 and the confirmation of homogeneity among the groups and statistically significant differences between the groups are reflected on both Welch statistic (0.041) and Brown-Forsyth statistic (0.043). This study reveals that there is significant variance among the mean scores on green supply chain initiatives diffusion and customers who transport environmentally-friendly goods (p-value = 0.000 less than 0.05). It is difficult to establish whether the association on these two variables is genuine environmental conscious, business related or ethically-based.

Table 1 further shows that in terms of business-related decisions on supply chain greening, significant variance exists among the mean scores (p-value = 0.000 less than 0.05) between green initiative diffusion and green logistical costs (mean = 3.95 and std deviation = 0.99). The mean variability in scores infers that companies are trying to reduce production and transport costs by implementing green supply chain logistics. Despite the interpretation of green supply chain management by the respondents as the use of eco-friendly materials, methods and practices throughout the supply chain (60.6%), the application of eco-friendly techniques at specific stages in the supply chain (36.3%) or as a tool adopted by managers to improve managerial performance (3.1%), there seems to be an understanding of both the environmental and business-related perspective on supply chain green initiative diffusion. The overwhelming majority of the respondents (76.9% on dichotomous questions) felt that information and awareness on greening initiatives are disseminated across functions and enterprises, while a highly convincing percentage of the respondents (81.9%) believe that company policies encourage the greening of logistics activities.

Hypothesis set four:

H_{4A}: The green initiative diffusion is related to the extent to which the organization's objectives are independently influenced by supply chain greening variables.

This set uses multiple regression to quantify the relationship between the dependent and independent variables. This is a flexible method of data analysis that may be appropriate when a quantitative criterion variable is to be examined in relationship to any factors as expressed as predictor variables. Table 1 shows that the multiple regression model from stepwise method (model 2) with two predictors (green logistical costs and routing schedules) produced R^2 = 0.392; $F_{(2;1560)}$ = 50.186; p-value = 0.000 less than 0.05 and Durbin-Watson (1.673). These results provide evidence of the existence of a linear relationship between the response (green initiative diffusion) and the two explanatory variables (green logistical costs and routing schedules). Although the first model (model 1) included only green logistical costs that accounted for 33.8% of the variance, the second model depicted improvement in including routing schedules by an additional 4.6% of the variance being explained and accounted for 38.4% (adjusted R^2 = 0.384). These two dimensions (green logistical costs with β = 0.509; p-value = 0.000 < 0.05 and routing schedules with β = 0.234; p-value = 0.000 < 0.05) are found to be considerably and statistically related with green initiatives diffusion. The Durbin-Watson value (1.673) is consistent with ideal range (between 1.5 and 2.5) of values with no problems of multicollinearity. Confirming these findings, the tolerance value is more than 0.10 and the VIF is below 10 as an indication that no multicollinearity occurred between items in the independent variables. It is also noted that green logistical

costs (model 1) has the highest beta value (0.58) between the two models. This study tentatively infers that both dimensions are related to green initiative diffusion; however, the green logistical costs make the strongest unique associated contribution to explaining the dependent variable when all the other variables in the model are controlled.

Reliability and validity. Researchers need to ensure the measure of the right concept, and measure the stability and consistency of the concept which is determined by reliability. For this research, reliability will be tested using Cronbach's Alpha which is a test for internal consistency. The reliability of the instrument is measured using the internal consistency method. Cronbach's Alpha values (0.66) shows construct validity and that the constructs are measured with sufficient reliability. This statistic provides an indication of the average correlation among all the items and thus reliability is achieved, as Cronbach's Alpha value is equal and/or greater than 0.6 (Bryman and Bell, 2007, p. 164). Validity can be determined by applying certain validity tests in order to measure the right concept (Bryman and Bell, 2007, p. 165). Content validity measured the adequacy of the sample (McBurney and White, 2004, p. 129) while criterion validity looked at the relationship between scale scores and some specified scores together with construct validity that measured the degree to which the scale measures the underlying concept it claims to measure (Beins and McCarthy, 2012, p. 68).

Administering survey. The questionnaire was self-administered through scheduled delivery and collection of questionnaires within agreed time intervals in order to enhance the return rate. The questionnaires were delivered to individual gatekeepers to administer the survey within their domain and most questionnaires were personally administered by the researcher within the Durban region, South Africa. The relevant letters (gatekeeper's letter, ethical clearance certificate, and consent letter to ensure confidentiality and anonymity) were shown to the gatekeepers and the researcher was given permission to conduct the study in each location.

Discussion and conclusion

Despite global campaigns advocating environmental preservation and sustainability, this study found that a lack of interest, support and cooperation from suppliers and customers does not have an effect on the adoption of green supply chain initiatives. It suggests that green supply chain initiative diffusion on renewable energy and packaging reduction should not be associated with customer-supplier pressure. Huge-Brodin et al. (2011) support the idea that a lack of customer/market support is a barrier to the adoption of green initiatives. In contrast, Mollenkopf, et al. (2010) maintain that supply chain members strongly influence firms' implementation of green and lean initiatives, if the customer's role is crucial for logistics providers in underpinning the development of green services. The work of Evangelista, et al. (2010) reveals that the size of an organization is related to the barriers and drivers (larger logistics service providers are not influential drivers among customers and managerial support); this study finds that the greening decision is independent of customers and suppliers. However, positive influence to successfully adopt green supply chain initiatives on the magnitude of green knowledge and information awareness does have an association with the positive performance targets set by the organization.

This study also sought to establish whether the organizations associate their businesses with customers that transport environmentally-friendly goods. The exiguous association on customer-supplier pressure and green initiatives further links with blur variance among the mean scores on green supply chain initiatives diffusion and transporting environmentally-friendly goods with genuine environmental conscious, business-driven or ethically-based association. In reformed strategic greening and sustainability, the significant impetus towards green supply chain initiatives epitomizes the willingness to protect the environment while conforming to environmental legislation and regulations. Frost and Sullivan's (2011) findings, suggest that, there is strong agreement that legislation is a driver of change in carbon reduction efforts and environmental awareness and that there is a fair degree of adoption of 'world class' green initiatives. These practices advocate both environmental- and business-driven initiatives with exiguous benefits for delivery efficiency. Business-related decisions on supply chain greening suggest that companies are attempting to reduce production and transport costs by using eco-friendly materials, techniques, methods and practices throughout the supply chain network. Company policies seem to be encouraging the greening of logistics activities, underpinning knowledge and information dissemination on greening initiatives and awareness across functional areas and supply chain extended enterprises. Supply chain re-alignment and streamlining of processes can help businesses cut down on wastage at various stages in the supply chain. However, the first step organizations need to take before implementing green initiatives is to decide on the role the environment plays in its operations. By aligning corporate goals with green supply chain goals, businesses will inevitably involve the upstream and downstream side of the supply chain regardless of the firm's positioning in the echelon network. The alignment of goals can

thus act as a catalyst for organizations to measure and monitor performance against world class standards and innovation is driven by transparency and visibility in the supply chain network. The extent to which organizational objectives on green supply chain initiative diffusion are independently influenced depends on the process of reducing production and transport operations costs through green logistics implementation while improving routing schedules in the road freight industry.

Managerial implications. The magnitude of green knowledge sharing and information visibility on green initiatives awareness should influence the potential of positive performance targets set by the organization. The aligned supply chain performance outcomes on green supply chain initiatives for renewable energy and packaging reduction by organizations should not reflect customer-supplier pressure for diffusion. Strategic, sustainability-driven organizations should be genuinely environmentally conscious from a business, societal and ethical perspective. The achievement of an organization's objectives on green initiative diffusion will depend on proper green logistics cost containment while optimizing routing schedules through supply chain realignment.

The degree of these challenges is dependent on many external factors such as government participation, legislation and regulation as well as supply chain collaboration. At present, logistics providers are challenged in implementing green logistics initiatives primarily due to, among other factors, the high cost of green adoption, limited access to technology and the lack of state intervention. However, the factors that drive companies to move towards greening lie in information awareness that enhances employee performance which has ripple effects on overall business efficiency. Thus 3PLs who pursue green methods adoption to enhance business performance achieve the benefits associated with greening. The findings of this study show that there is a clear relationship between logistical road operations and the effect of green supply chain management. Green supply chain management has a positive effect on logistical road operations by minimizing transportation miles, reducing carbon emissions and optimizing the distribution network. These green supply chain management strategies are responsible for the overall effectiveness of green logistics systems. The magnitude of collaboration amongst supply chain trading partners in implementing green supply chain management initiatives is relatively minimal, suggesting that this area requires attention in order for companies to fully realise the benefits of going green.

The findings will be especially applicable to the Durban region as it houses Africa's busiest general cargo port and is home to one of the largest and busiest container terminals in the Southern Hemisphere. Hence, these results pave the way for the Durban road freight industry to enhance and encourage the adoption of green logistics and supply chain management initiatives. Future research should include an examination of the extent to which supply chain collaboration with governmental organizations can influence green initiatives adoption in the logistics industry. However, in order to determine the relationship between intermodal transportation flows and the challenges faced by transport operators in going green, it is imperative to understand the impact of technology and human capital on green sustainable supply chains as this period of transition will require thorough scrutiny.

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