Journal of Transport and Supply Chain Management
ISSN: (Online) 1995-5235, (Print) 2310-8789

The impact of green supply-chain management on logistics performance in the construction sector in South Africa

Authors:
Elizabeth C. Chinomona[1]
Marie B. Bikissa-Macongue[1]

Affiliations:
[1]Department of Logistics and Supply Chain, Faculty of Management Sciences, Vaal University of Technology, Vanderbijlpark, South Africa

Corresponding author:
Elizabeth Chinomona,
elizabethc@vut.ac.za

Dates:
Received: 07 Feb. 2022
Accepted: 18 Apr. 2022
Published: 20 July 2022

How to cite this article:
Chinomona, E.C. & Bikissa-Macongue, M.B., 2022, 'The impact of green supply-chain management on logistics performance in the construction sector in South Africa', *Journal of Transport and Supply Chain Management* 16(0), a752. https://doi.org/10.4102/jtscm.v16i0.752

Background: As a result of globalisation and the growing importance of environmental and social issues, construction companies are expected to reduce the environmental impact of their day-to-day activities and make the industry more environmentally friendly. Many research works published have ignored the critical parameters and dimensions of green supply-chain management (GSCM) and logistics performance as environmental protective practices in the construction industry. Therefore, there is a need to investigate how the construction sector should implement GSCM programmes and logistics performance as environmentally friendly practices in their business activities, which would be beneficial to all stakeholders.

Objectives: The present study intends to fill this gap by analysing the impact of environmentally friendly practices, such as GSCM and logistics performance in the construction industry in southern Gauteng. This study considered regulatory pressure, green information systems, green packaging, reverse logistics and logistics performance as environmental protective practices.

Method: This study adopted a quantitative approach to survey a sample of 440 suppliers and purchasers' managers from construction companies in the southern Gauteng province. A judgemental or purposive sampling technique was applied to collect data from respondents. Data were analysed with the aid of Statistical Package for Social Science (SPSS 27.0) and Analysis of Moment Structures (AMOS 27.0). In addition, confirmatory factor analysis and structural equation modelling were used to analyse the relationship between constructs and test the hypotheses.

Results: This study revealed that regulatory pressure, green information systems, green packaging and reverse logistics significantly influence logistics performance of construction companies.

Conclusion: Study demonstrated that through GSCM and logistics performance, construction companies can correlate their business activities and the environment effectively.

Keywords: green supply chain management; regulatory pressure; green information system; green packaging; reverse logistics; logistics performance.

Introduction

Resource limitations and environmental concerns have made sustainable operations of assets and environmental pollution one of the major concerns across industries. As a result, companies around the globe are expected to be mindful of their operations and move towards safer and more sustainable production (Lu et al. 2019). Accordingly, Badi and Murtagh (2019) believed that economic development goes hand-in-hand with the reduction of pollution and the sustainable management of resources (Cui et al. 2019; Wang 2021). This calls for the implementation of environmentally driven activities within industries.

Srivastav and Gaur (2015) observed that although there has been a significant improvement in various industries such as retail, services and agriculture in terms of going green, Atanda and Olukoya (2019) and Mittal (2021) found that the construction industry still lags behind, despite their ability to stimulate growth. Wu, Zhao and Ma (2019) argued that there is a conflict between going green and construction activities. The authors further explained that the underlying reason for this conflict is the incorporation of environmental, economic and social parameters of sustainability into the core activities of construction companies, which has resulted in processes, knowledge, skills and experience being altered. For instance, Srivastav and Gaur (2015) claimed that things such as the purchasing of advanced and modern technologies, teaching, training employees through different educational programmes or even hiring already-qualified specialists in green practices would be expensive, which makes it difficult for the top management of construction companies to encourage and prioritise environmentally friendly practices. Also, technologies are developing very rapidly, such that picking the one suitable for companies is a long and laborious process (Jerzyk 2016).

Managers and employees in the construction sector would greatly benefit from insights attained from the empirical analysis. This study contributes to the knowledge by analysing the impact of environmentally friendly practices such as regulatory pressure, green information systems (GIS), green packaging and reverse logistics (RLs) on the logistics performances (LPs) of construction companies in southern Gauteng. After an intensive literature review, these variables were selected based on the fact that they immensely affect RL and LP. The reflection is expanded on the basis of the literature review, research methodology, tests of measures, accuracy of analysis statistics and discussion of the results.

Problem statement

Most prior research on moving construction towards sustainable development focused on drivers and barriers in developed countries, and relatively little attention has been devoted to developing countries such as South Africa (Muhammad et al. 2014). Mafini and Loury-Okoumba (2018) posited that because countries such as South Africa are still developing, the level of environmental mindfulness amongst construction companies is still low; therefore, there is a need to conduct more studies on issues within such enterprises. Moreover, despite the fact that environmental protection is an increasing concern for organisations worldwide (Mafini & Loury-Okoumba 2018), the growing body of research linking environmental sustainability and construction activities in developing countries such as South Africa is still evolving, leaving little information to contribute to the research gap (Cui et al. 2019; Wang 2021). Although several studies have been carried out to address the current problem, the application or implementation and the influence of green supply chain management (GSCM) and LP in the construction industry has not been given much attention. Therefore, there is a need to investigate the impact of GSCM and LP in the construction industry, which is the focus of this study.

Literature review

This literature review outlines the theory applied to this study and the five major concepts of this article, which include regulatory pressure, GIS, green packaging, RL and LP.

Eco-efficiency theory

In the past few years, a range of concepts and ideas has been introduced to move towards sustainability. However, eco-efficiency is perceived by many as a central idea (Yang & Yang 2019). Whilst many definitions exist to explain the concept of eco-efficiency, the most cited definition is the one by the World Business Council for Sustainable Development (WBCSD) as the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, whilst progressively reducing ecological impacts and resource intensity throughout the life cycle to a level at least in line with Earth's estimated carrying capacity. In other words, eco-efficiency is about reducing environmental damage whilst maximising the efficiency of a company's production process, which in turn leads to cleaner production (Yan et al. 2021). An eco-efficiency approach supports that organisations must have a strong focus on social innovation, accountability, transparency and technology to coordinate their operations with the environment in order to mitigate ecological problems (Yang & Yang 2019). To achieve eco-efficiency, Li, Sarwar and Jin (2021) claimed that organisations must decrease resource consumption, extend product or service utility, maximise sustainable use of renewable resources and increase service intensity. In this regard, GSCM and LP can be used to achieve eco-efficiency and, as a result, support the economic development of the construction industry. Therefore, in this study, eco-efficiency is used to provide a theoretical mechanism through which it is possible to explain the relationship between regulatory pressure, GIS, green packaging, RL and LP in construction companies.

Construction industry in South Africa

The construction industry of South Africa, like any other country, is divided into two sectors, namely formal and informal sectors. The formal sector refers to the formal side of a country's economy, which includes all companies involved in legal activities (Heil 2018). The informal sector, on the other hand, refers to the second part of the country's economy, which encompasses all informal companies that operate illegally (Mittal 2021). Construction companies have come up with solutions in order to address sustainability. They support national and local development and maintain a sustainable environment (Herrmann et al. 2021). Modise (2018) stated that South African construction companies have accentuated the development of a sustainable structure for their activities and accepted global environment and economic changes by promoting growth and up-skilling the workforce with the intention of forming flexible, efficient and effective artisans. Okonkwo (2019) believed that construction companies are crucial to introduce sustainability thinking within other industries such as tourism, agriculture and transport. In addition, Kukhnin and Spiridonova (2015) posited that in order to strengthen relationships with the communities, construction companies must increase their efforts and contributions to small and poorer areas of the country.

In South Africa, like any country in the world, the construction industry encounters many challenges which affect its performance and the socio-economic development of the country. Effectively, Modise (2018) stated that since the World Cup projects in 2010, the industry has fallen considerably. Siziba (2019) claimed that internal and external challenges have negatively impacted the bottom line of the construction sector. Although the construction industry is a key indicator of socio-economic development and receives support from the government, the industry must pay attention to skills shortage, the weakening rand, corruption, power and supply shortages and industrial unrest. In this study, the rationale was to focus on the influence of GSCM and logistic performance in the construction industry.

Regulatory pressure

To preserve energy and reduce emissions of carbon, numerous countries have established agencies and regulations for environmental sustainability and protection (Huang & Yang 2014). As the construction industry plays a substantial role in environmental health, economic stability and human welfare, the South African government has developed rules and regulations to minimise its environmental impact (Bond 2018). In South Africa, construction companies must adhere to the Environmental Impact Assessment Act No. 253 of 1998 (Construction Health and Safety 2007). According to its preamble, the Act advocates the evaluation of the environmental impact of a proposed construction project or development, taking into account inter-related socio-economic, cultural and human health impacts, both beneficial and adverse. Therefore, to comply with the new ecofriendly regulations, enjoy goodwill and avoid the risk of fines or penalties, construction companies have to accept or implement environmentally friendly practices (Mittal 2021). This has, ultimately, led to GIS being created because of high regulatory pressure.

Given their central position in the supply chain, shaping the logistics activities of small or large construction companies can represent a greater opportunity to achieve environmental sustainability. As a result, they may feel the need to work harder, faster and better, particularly as they are keenly aware that the effectiveness of their logistics system is linked to their ability to respond to environmental pressure (Wang 2021). For instance, the growing emphasis on the liberalisation of return policies, customer satisfaction and the reuse of parts has lengthened product life cycles, resulting in an increase in backward flow of products through the supply chain, placing more weight on RL. Cui et al. (2019) and Yan et al. (2021) concurred that RL is the means by which logistics providers can become more proficient in handling returned goods and achieve better performance. Nevertheless, Huang and Yang (2014) and Gelzinis (2021) claimed that without a proper flexible information system capable to drive changes, compliance cannot take place. The authors further posit that the principal concern of environmental laws and regulations is to match the changes in the external environment with the existing organisational capabilities. By destroying an old information system in favour of a sustainable one, companies can easily match or balance the environment with their daily activities (Atanda & Olukoya 2019); therefore, it can be postulated that:

> H1: There is positive and significant relationship between regulatory pressure and green information systems.
>
> H2: There is positive and significant relationship between regulatory pressure and RL.
>
> H3: There is positive and significant relationship between regulatory pressure and LP.

Green information systems

Referred to as an organisational system designed to collect, process, store and distribute information in order to achieve environmental sustainability, a GIS is a capable means by which businesses may partially solve many environmental problems (Anthony 2019). Debnath (2018) and Li and Huang (2021) posited that a GIS is composed of computer hardware and software, databases and data warehouses, telecommunications, human resources and procedures. The authors further state that these systems speed up the pace of daily activities, enabling people to develop and maintain a relationship and influence the nature of work.

In this era, where organisation revolves around the Internet, it is necessary for construction companies to have accurate and reliable information systems capable of changing societal behaviours by backing the shift to a more sustainable society (Mittal 2021). Debnath (2018) explained that GIS can help organisations determine which activities are harmful to the environment, make ecological decisions and take corrective actions. Ergen (2021) added that GIS is a very practical tool, which has led to the implementation of sustainable activities such as increasing communication in different functional units and improving production efficiency and management capabilities, as well as creating green initiatives (Mittal 2021).

For example, Yan et al. (2021) claimed that the successful development of green initiatives such as green packaging and RL rely on the ability of GIS to increase communication and coordinate activities within the chain. Accordingly, Anthony (2019) argued that green packaging and RL are complex and special areas of the supply chain that require the collaboration or interaction of different parties. Gelzinis (2021) posited that green packaging needs to be connected to the entire chain of features, which include logistics, marketing, production and environment aspects with the help of GIS (Yan et al. 2021). In addition, RL also requires the synchronisation of all the parties involved through GIS, which are suppliers, logistics service providers, buyers, customers and more. In order to coordinate all these activities, information needs to flow throughout the organisation and that makes GIS the key principle. Therefore, through GIS, construction companies can gain information needed for managing and coordinating their activities within the supply chain in terms of ecodesign, production, packaging, recycling, disposal, scrap ratio and more (Ergen 2021; Srivastav & Gaur 2015). Drawing from the foregoing arguments, this study hypothesises that:

H4: There is positive and significant relationship between green information systems and green packaging.

H5: There is positive and significant relationship between green information systems and reverse logistics.

Green packaging

The green or environmentally friendly package is the use of materials and manufacturing methods for the packaging of goods with minimal impact on the environment (Choudhary et al. 2019). The main purpose of packaging is to provide protection to the product from dirt, insects, dampness, breakage, contamination and damage (Blazquez, Galeotti & Martin-Moreno 2021). Packaging is not only used to secure the goods in transit from the manufacturer to the final destination, but it also prevents damage whilst products stay on construction retail shelves (Wilcox 2021). As packaging is perceived before the product, it plays a fundamental role in the successful design and management of the operations in logistics and a RL system (Jerzyk 2016). In logistics, packaging is used to ensure the physical distribution of goods (Yang & Yang 2019). A successful logistics system requires the packages to be as easy as possible to handle and reuse, through all processes and for customers (Debnath 2018). An integrated management of the green packaging system from the strategic, tactical and operational point of view allows construction retailers to find the optimal management of the packaging system and reduce the logistics cost. Jerzyk (2016) argued that products must be contained in ecological packaging to ensure their safety and make logistics and a RL system more efficient and effective. Moreover, Choudhary et al. (2019) added that the absence of a RL system makes it impossible for construction companies to take advantage of the opportunities of green packaging of products (Li et al. 2021). In other words, to enjoy the advantages of green packaging, construction companies must put in place a good reverse system or programme. In addition, some authors posit that green packaging creates an avenue to add value through RL of returnable and reusable assets (Yan et al. 2021).

Referring to Wilcox (2021), green packaging has become an increasingly important segment of the overall push in industry towards environmentally conscious companies to achieve LP. In fact, it can be a significant tool for obtaining competitive edge, building and communicating brand value and influencing consumer behaviour and influencing LP (Bond 2018). Therefore, green packaging is not only a package of general performance, it can also be used as a renewable resource and protect the environment, ultimately, leading to LP. Deducing from the aforementioned discussion, this study posits that:

H6: There is positive and significant relationship between regulatory pressure and LP.

H7: There is positive and significant relationship between green packaging and LP.

Reverse logistics

Usually, supply chain networks ensure that materials flow from suppliers to end customers efficiently (Niroomand 2017; Sharma et al. 2021). However, the mission of the supply chain does not only end when products reach the end users. Accordingly, Robinson (2019) posited that a supply chain network must also ensure reverse flow of products, as products can be returned for many reasons. Reverse logistics, however, is described as the set of activities conducted after the sale of a product to recapture value and end the product's life cycle (Yan et al. 2021). According to Sharma et al. (2021), RL is perceived as the best practice to enhance going greener and the greener productivity of any logistics systems. Reverse logistics provides a wide range of opportunities for improvement, ranging from transportation, storage, customer service and returns processing to supplier management and unexpected revenue sources (Li et al. 2021). Thaba (2017) and Sharma et al. (2021) concurred that RL has the ability to provoke internal and external changes, as well as adjusting to the continuously unexpected changes in the market needed to consolidate a logistics network. Sharma et al. (2021) claimed that if well implemented, RL can boost the LP of construction companies through reducing costs, improving quality, enhancing flexibility and speed of the logistics network.

By capturing value from the used products, RL can capture ecological and economic benefits. Niroomand (2017) observed that RL can help companies to compete in their industry, especially when confronting intense competition and low profit margins. The author further states that companies can use RL as a means of competitive differentiation. Furthermore, Hashemi (2021) highlighted that an effective RL would lead to higher sales revenue and reduced operational costs of the companies. Drawing from the foregoing reflections, this study postulates that:

H8: There is positive and significant relationship between reverse logistics and LP.

Logistics performance

According to Liu et al. (2018), LP can be defined as the efficiency and effectiveness of a company in performing logistics activities with less environmental impact. Amongst countries, LP is decisive for social and economic development and environmental sustainability (Thaba 2017). By reducing the transport emissions of gases, shortening the transportation distance, decreasing waste products, lowering the energy consumed, aligning with government regulations and increasing environmental awareness amongst customer bases, logistics can contribute or promote environmental sustainability.

Empirical studies have recognised LP as a source of business growth (Sharma et al. 2021). Indeed, enhancing existing or developing new logistics capabilities can create value for customers and the company (Magazzino, Adewale-Alola & Schneider 2021; Tuan 2018). Logistics performance, therefore, helps businesses to differentiate themselves from their competitors (Niroomand 2017). In fact, by delivering the goods at the right place, time, quality and quantity, logistics services empower organisations to customise services in order to meet the needs of individual customers and create value for them. Achieving LP is the focus of any organisation because it is only through LP that companies are able to grow and progress.

Conceptual framework

A framework was conceptualised after an intense literature review, specifically to study the relationship between regulatory pressure and green packaging (which are perceived as predictor variables), two mediating variables (that is, GISs and RL) and one outcome variable, which is LP. The following figure shows a framework of the constructs and the hypothesised relationships investigated in the study.

Research methodology

The research methodology section provides an overview of the research approach, sampling design, procedures for data collection, instrumentation and data analysis used in this study.

Research approach

For this study, the quantitative approach was applied, as it can be used for a large sample which is representative of the population and data that can be collected with ease and organised using graphs and charts. Also, this method is suitable because the study involved the testing of eight hypotheses, suggesting the existence of relationships between five different variables.

Target population and sampling design

The target population in this study was the South African construction companies in southern Gauteng province. The construction companies in this survey were owner builders, small renovation contractors and general builders. It was not possible to have an exact number of construction companies in southern Gauteng because of the lack of a formal list. Given the inability to obtain a single sample frame from which a list of construction companies could be obtained, participants were selected using a nonprobability sampling technique. Purposive sampling was selected to draw 440 respondents relevant to this study (Quinlan et al. 2019). Respondents were typically selected from the logistics, supply chain and operations departments as the research area was somewhat relevant to the activities of these departments. A total of 440 questionnaires were initially distributed to respondents. A total of 50 unusable questionnaires were discarded in the screening process, culminating in a 86.6% (*n* = 381) response rate.

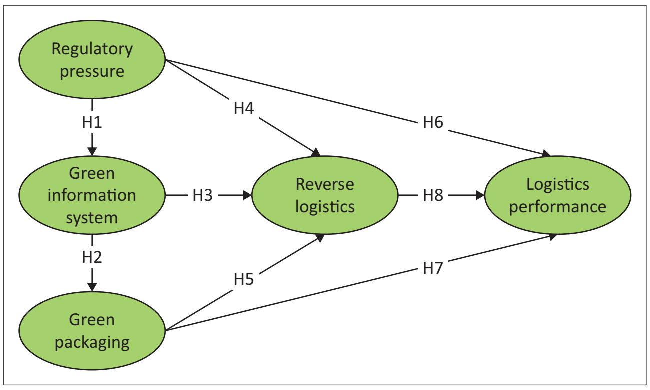

FIGURE 1: Conceptual model.

Procedures for data collection and measurement instruments

Data were collected through the distribution of questionnaires developed from the past literature. The existing items were adapted to suit this study. For this reason, questions were reformulated. Regulatory pressure was measured with six measurement items adapted from Khor et al. (2016). Green information systems were measured with seven questions extracted from the study of Liu et al. (2018). Green packaging was measured with four questions adapted from the study of Salhieh and Abushaikha (2016). Reverse logistics was measured with five measurement items adapted from Ye et al. (2013), whilst LP was measured with nine questions extracted from the study of Aharonovitz, Vidal-Vierra and Suyama (2018). The response options were arranged in a five-point Likert scale configuration calibrated as follows: 1 = strongly disagree, 2 = disagree, 3 = moderately agree, 4 = agree and 5 = strongly agree.

Ethical considerations

The Faculty Research Ethics Chair and committee approved the study (reference no. FRECMS-21102020-049 215240448).

Result of the study

In this study, the Statistical Packages for the Social Sciences (SPSS version 27.0) and Analysis of Moment Structures (AMOS 27.0) were used. In addition, simple descriptive statistics were used to analyse the demographic details of respondents, whilst confirmatory factor analysis (CFA) and structural equation modelling were used to analyse the relationship between constructs and test hypotheses.

Descriptive statistics

The descriptive analysis showed that the majority of the respondents were male (*n* = 296; 77.7%; *n* = 85; 22.35%). The analysis showed that in a total of 381 respondents, 36% (*n* = 136) were between 27 and 36 years, around 24.4% (*n* = 93) of the respondents were aged between 17 and 26 years, whilst 23.4% (*n* = 89) were aged between 37 and 46 years and 16.2% (*n* = 62) were aged 47 years and above. There were more black respondents (*n* = 305; 80.6%) than white respondents (*n* = 40; 10.5%). The Indian and other races represent the minority of the construction workforce with 1.3% (*n* = 5) for Indian respondents and 0.5% (*n* = 2) for other races.

Measurement and scale accuracy

To assess the reliability and validity of the research constructs, three tests known as Cronbach's alpha, composite reliability (CR) and average value extracted (AVE) were conducted. The results of these tests are reported in Table 1. This table equally provides the results of the means, standard deviation, item-totals and factors loading.

During the cleansing process or the scale purification, item-to-total correlations were computed and were expected to be above the minimum threshold of 0.5 (Hair et al. 2010). Using this criterion (except GS7 that was disregarded because its item-to-total correlations was less than 0.5), all the factor loadings of the measurement items were acceptable for their range from 0.522 to 0.831. To assess reliability of each construct, the Cronbach's alpha test and the CR tests were computed. According to Hulland (1999), the recommended minimum value is supposed to be 0.7 for both Cronbach's alpha and CR in order for measurement scales to be classified as reliable. Table 1 shows that all the Cronbach's alpha values for each research construct range from 0.846 to 0.914. The lowest value is 0.846, which is above the recommended threshold and indicated a higher degree of internal reliability and consistency of the measures used.

TABLE 1: Scale accuracy analysis.

Research constructs	Cronbach's test		CR value	AVE value	Factor loading
	Item total	α value			
Regulatory pressure					
RP1	0.588	0.865	0.865	0.504	0.522
RP2	0.720				0.653
RP3	0.719				0.752
RP4	0.622				0.779
RP5	0.691				0.827
RP6	0.633				0.684
Green information systems					
GS1	0.593	0.867	0.867	0.527	0.687
GS2	0.721				0.739
GS3	0.632				0.689
GS4	0.738				0.805
GS5	0.630				0.727
GS6	0.700				0.706
GS7	0.484				0.475
Green packaging					
GP1	0.714	0.863	0.863	0.608	0.791
GP2	0.762				0.820
GP3	0.757				0.789
GP4	0.628				0.717
Reverse logistics					
RL1	0.542	0.846	0.846	0.522	0.553
RL2	0.645				0.765
RL3	0.736				0.831
RL4	0.701				0.745
RL5	0.650				0.690
Logistics performance					
LP1	0.643	0.914	0.914	0.523	0.634
LP2	0.704				0.726
LP3	0.733				0.740
LP4	0.757				0.782
LP5	0.778				0.801
LP6	0.776				0.811
LP7	0.751				0.778
LP8	0.51				0.591
LP9	0.664				0.671

CR, composite reliability; AVE, average value extracted; RL, reverse logistics; LP, logistics performance.

In this study, the validity was tested by means of convergent and discriminant validity. To assess convergent validity, factor loadings for the individual scale items were computed. For consistency when assessing the items, factor loadings should be greater than 0.5 (Fraering & Minor 2006). Using this recommendation, the majority of the factor loadings of the measurement items were acceptable for their range, between 0.522 and 0.831, except for GS7, which was discarded from the scales because it had factor loadings below 0.5. Convergent validity was further checked using the AVE. Average value extracted was calculated using the formula of Fornell and Larcker (1981), which recommends that the AVE value should be greater than 0.5. The AVE values represented in Table 1 range from 0.504 to 0.608; therefore, good representation of the latent construct by the items is authenticated. To check for discriminant validity, interconstruct correlation matrix was used. The study followed Chinomona's (2011) and Chinomona and Bikissa-Macongue's (2021) recommendation that correlation coefficients of less than 1.0 are an indicator of adequate discriminant validity. The results are indicated in Table 2.

An analysis of Table 2 reveals a significant interfactor correlation ranging between $R = 0.318$ and $r = 0.527$, which all fell within the recommended threshold values. Effectively, according to Chinomona (2011), the discriminant validity is to assess if the correlation between the research constructs is less than 1.0. As indicated in Table 2, the intercorrelation values for all paired latent variables are less than 1.0, confirming the existence of discriminant validity.

Structural equation modelling

After approving the reliability and validity of the measurement instruments (reported in Table 1), the study proceeded to test the proposed hypotheses, anticipating that regulatory pressure, GISs, green packaging and RL have a significant influence on LP of construction companies in southern Gauteng.

Model fit results

This literature asserts that a chi-square value over degree of freedom below three is an indication of acceptable model fit (Trochim 2020; Xia & Yang 2018). Confirmatory factor analysis was run first and results in Table 3 show that the indicator value for chi-square over degree of freedom is 1.634, which

TABLE 2: Interconstruct coefficient.

Research construct	Construct correlation				
	RP	GS	GP	RL	LP
Regulatory pressure (RP)	1.000				
Green information systems (GS)	0.527**	1.000			
Green packaging (GP)	0.318**	0.412**	1.000		
Reverse logistics (RL)	0.303**	0.336**	0.425**	1.000	
Logistics performance (LP)	0.237**	0.435**	0.478**	0.498**	1.000

**, Correlation is significant at the 0.01 level (2-tailed).

TABLE 3: Model fit results (confirmatory factor analysis).

Model fit indices criteria	Results
Chi-square (CMIN/DF)	1.634
Normed fit index (NFI)	0.917
Increment fit index (IFI)	0.966
Tucker-Lewis index (TLI)	0.956
Comparative fit index (CFI)	0.966
Goodness-of-fit index (GFI)	0.907
Adjusted goodness-of-fit index (AGFI)	0.874
Root mean square error of approximation (RMSEA)	0.041

TABLE 4: Structural equation modelling fit results.

Model fit indices criteria	Results
Chi-square (CMIN/DF)	1.595
Normed fit index (NFI)	0.923
Increment fit index (IFI)	0.970
Tucker-Lewis index (TLI)	0.959
Comparative fit index (CFI)	0.969
Goodness-of-fit index (GFI)	0.914
Adjusted goodness-of-fit index (AGFI)	0.878
Root mean square error of approximation (RMSEA)	0.043

indicates acceptable model fit. Furthermore, Table 3 shows that normed fit index (NFI) (0.917), increment fit index (IFI) (0.966), Tucker-Lewis index (TLI) (0.956), comparative fit index (CFI) (0.966) and goodness-of-fit index (GFI) (0.907) meet the recommended threshold of 0.9 as suggested by Bagozzi and Yi (2012), which signifies good model fit. In addition, adjusted goodness-of-fit index (AGFI) is equal to 0.874, which is close to the acceptable threshold of 0.9, and therefore is acceptable and fits the model, according to Baumgartner and Homburg (1995) and Doll, Xia and Torkzadeh (1994), who suggest that the value is acceptable if above 0.8. The RMSEA is less than the minimum threshold of 0.08 (Xia & Yang 2018), as presented in Table 3.

By scrutinising these eight goodness-of-fit assessment statistics, it can be observed that all of them meet their respective recommended thresholds; therefore, it can be concluded that the data are fitting the model.

Model fit assessment

Table 4 shows that the degrees of freedom of the chi-square value is 1.595. This value is below the recommended threshold of three suggested by Bone, Sharma and Shimp (1989), which indicates an acceptable fit. Moreover, Table 4 indicates that the value of AGFI (0.878), which is close to the standard threshold recommended, is acceptable and fits the model accurately, according to Baumgartner and Homburg (1995) and Doll et al. (1994) who suggested that the value is acceptable if above 0.8. Furthermore, Table 4 shows that NFI (0.923), IFI (0.970), TLI (0.959), CFI (0.969) and GFI (0.914) meet the recommended threshold of 0.9 as suggested by Bagozzi and Yi (2012) and Blair (2016), which signifies good model fit. Finally, RMSEA is 0.43, less than the minimum threshold of 0.08, which validates good model fit.

Given that all eight goodness-of-fit indices provided in Table 5 meet their respective recommended thresholds, it can be concluded that the data fit the model.

TABLE 5: Results of hypotheses testing (path modelling).

Proposed hypothesis relationship	Hypothesis	Path coefficient estimates
Regulatory pressure → green information systems	H1	0.620 ***
Green information systems → green packaging	H2	0.520***
Green information systems → reverse logistics	H3	0.381***
Regulatory pressure → reverse logistics	H4	0.315***
Green packaging → reverse logistics	H5	0.474***
Regulatory pressure → logistics performance	H6	0.384***
Green packaging → logistics performance	H7	0.510***
Reverse logistics → logistics performance	H8	0.535***

***, Significance level $p < 0.001$.

Discussion of the results

This study aimed to test the relationship between regulatory pressure, GISs, green packaging, RL and LP in construction companies in southern Gauteng. The first research objective was to examine the relationship between regulatory pressure and GISs. A coefficient of 0.620 was realised after testing H1. This indicates that regulatory pressure has a strong and positive influence on GISs. The results, therefore, support the relationship as hypothesised. Judging from the results, it can be understood that regulatory pressure raises awareness of environmental issues and creates normative responses that promote the application of a GIS. Also, in support of Hypothesis 2 (H2), the results validated the presence of a relationship between GISs and green packaging with a path coefficient of 0.520. This denotes that GISs have a positive and relatively strong influence on green packaging, which concurs with the results of the studies of Ahmed et al. (2018) and (Sharma et al. 2021), where GISs are positively associated with green packaging.

The third research objective was to investigate the relationship between GISs and RL. The path coefficient for Hypothesis 3 (H3) is 0.381, which indicates a reasonable relationship between the two variables. Accordingly, this study validates and supports that GISs have a direct impact on RL. The fourth hypothesis (H4) showed that regulatory pressure is strongly associated with RL. The relationship is validated based on the results of the path coefficient ($r = 0.315$) and the regression path is reasonably significant ($p < 0.001$). This study validates and supports that regulatory pressure positively influences RL. The result indicates that the pressure that comes from legislations and regulations is one of the most crucial reasons for practising RL.

The results acquired after the testing of H5 validated the presence of the relationship between green packaging and RL, when a path coefficient of 0.474 was exhibited. This denotes that green packaging has a strong positive influence on RL. Based on the results, it can be indicated the greener the packaging, the more effective RL practices will be. The relationship between regulatory pressure and LP was confirmed by the results obtained after testing H6, when a coefficient of ($r = 0.384$) was realised. This means that regulatory pressure has a positive and reasonable influence on LP. After analysis, it can be acknowledged that regulatory pressure represents an opportunity for companies to improve the performance of their logistics activities.

The results obtained following the test of H7 verified that there is a relationship between green packaging and LP, when a coefficient of (r = 0.510) was revealed. This connotes that green packaging has a positive and strong relationship on LP. The results, therefore, substantiate the relationship as hypothesised. The last objective was to examine the relationship between RL and LP. A coefficient of 0.535 was realised after testing H8. The results, therefore, validate the relationship as hypothesised. When analysing the results, it was shown that when construction companies embrace RL practices, the performance of their logistics activities will be improved. Therefore, results show that construction companies all over the globe need to re-evaluate the benefits of implementing environmentally friendly practices such as regulatory pressure, GISs, green packaging and RL to enhance LP, which as a result will lead to sustainability. In addition, Magazzino et al. (2021) implied that the development and integration of regulatory pressure, a GIS, green packaging and RL throughout logistics enables logisticians to recapture higher value, enhance customer relationships, achieve competitiveness and improve effective and efficient management of logistics activities or systems. Simply put, environmental sustainability and economic growth can be achieved through these practices. Results for hypothesis 1 and hypothesis 8 show that their relationship is very strong compared with others; therefore, management and government should put more emphasis on regulatory pressure, a GIS and RL to ensure LPs that are sustainable.

Conclusion

This study provides several research contributions and managerial implications. Firstly, based on eco-efficiency theory, it provides a holistic view of examining the interplay between regulatory pressure, a GIS, green packaging on RL and LP. It reveals that by developing and implementing green supply chain practices, the LP of construction companies can be enhanced. In addition, the study reveals that GSCM and LP can be used to develop a firm-specific standard procedure for the ecological management of construction activities. In this way, managers should implement GSCM and LP, not only to achieve sustainability but also to maximise overall stakeholders' value. This study also contributes to the knowledge on how construction companies can provide a solution to environmental challenges that the world is currently facing. The findings of the study suggest that by developing and implementing green supply chain practices, the LP of construction companies can be enhanced. Thus, this study proposes an additional contribution to the existing literature because it amplifies and reinforces new knowledge within the supply chain and logistics field by giving guidance on how to achieve greater profits, sustainability and performance in a construction company. Finally, a conceptualised model and data collected from a large provincial population and an acceptable methodology and hypotheses were provided to boost the literature on sustainability development theory.

Limitations and suggestions for further research

Although this study makes significant contributions to both academia and practice, there are some limitations which open up avenues for further research. Firstly, the study is limited because data were collected from construction companies based in southern Gauteng only. In line with this, future studies could be conducted in other provinces, which is likely to provide the results of the study within a broader context. Another limitation is its restriction to only five environmental protection strategies. This gives the opportunity for future studies to explore other strategies such as green training, green image and more. Moreover, the usual limitations surrounding the survey method of data collection are acknowledged in this study. Future studies can therefore use different methods, such as a mixed method, to obtain a better picture of the study. In addition, future studies can use a qualitative approach only to get in-depth information from respondents through interviews or focus groups. Also, this study may provide added insights and contribute new knowledge to the existing body of supply chain management literature in Southern Africa and beyond.

Acknowledgements

The authors would like to acknowledge Prof. Mafini, who contributed as a critical reader for this article.

Competing interests

The authors declare that they have no financial or personal interests, which may have inappropriately influenced them in writing this article.

Authors' contributions

M.B.B-M. first wrote the original article and E.C.C. edited and checked everything in the article to ensure that it was in order.

Funding information

This research received no funding from any organisation, be it public, commercial or not-for-profit sectors.

Data availability

The study generated its raw data and its available upon request from the corresponding author.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not reflect the official policy or position of any affiliated agency of the authors.

References

Aharonovitz, M.C.S., Vidal-Vieira, J.G. & Suyama, S.S., 2018, 'How logistics performance is affected by supply chain relationships', *The International Journal of Logistics Management* 29(1), 284–307. https://doi.org/10.1108/IJLM-09-2016-0204

Ahmed, S., Khan, A., Paul, S. & Kazmi, S.H.A., 2018, 'Role of green information system and information cycle in environmental performance', in J. Xu, F. Cooke, M. Gen & S. Ahmed (eds.), *Proceedings of the Twelfth International Conference on Management Science and Engineering Management. ICMSEM 2018. Lecture Notes on Multidisciplinary Industrial Engineering*, pp. 465–467, Springer, Cham.

Anthony, B., Jr., 2019, 'Green information system integration for environmental performance in organisations: An extension of belief–action–outcome framework and natural resource-based view theory', *Benchmarking: An International Journal* 26(3), 1033–1062. https://doi.org/10.1108/BIJ-05-2018-0142

Atanda, J. & Olukoya, O., 2019, 'Green building standards: Opportunities for Nigeria', *Journal of Cleaner Production* 227, 366–377. https://doi.org/10.1016/j.jclepro.2019.04.189

Badi, S. & Murtagh, N., 2019, 'Green supply chain management in construction: A systematic literature review and future research agenda', *Journal of Cleaner Production* 2(23), 1–32. https://doi.org/10.1016/j.jclepro.2019.03.132

Bagozzi, P.R. & Yi, Y., 2012, 'Specification, evaluation, and interpretation of structural equation models', *Academy of Marketing Science* 40, 8–34. https://doi.org/10.1007/s11747-011-0278-x

Baumgartner, H. & Homburg, C., 1996, 'Applications of structural equation modeling in marketing and consumer research: A review', *International Journal of Research in Marketing* 13(2), 139–161. https://doi.org/10.1016/0167-8116(95)00038-0

Blair, L., 2016, 'Choosing a methodology', in *Writing a graduate thesis or dissertation, teaching writing series*, Sense Publishers, Rotterdam.

Blazquez, J., Galeotti, M. & Martin-Moreno, J.M., 2021, 'Green recovery packages for a post-Covid-19 world: A lesson from the collapse of Spanish wind farms in the past financial crisis', *Renewable and Sustainable Energy Reviews* 151, 235–276. https://doi.org/10.1016/j.rser.2021.111570

Bond, J., 2018, *Adding value through compliance: The benefits of good practice for businesses*, viewed 02 April 2019, from https://www.lexology.com/library/detail.aspx?g=9a4ef70e-39c2-4844-80f1-c9caac79b1ad-.

Bone, P., Sharma, S. & Shimp, T., 1989, 'A bootstrap procedure for evaluating goodness-of-fit indices of structural equation and confirmatory factor models', *Journal of Marketing Research* 26(1), 105–111. https://doi.org/10.1177/002224378902600109

Chinomona, E. & Bikissa-Macongue, 2021, 'The effects of loyalty, satisfaction and motivation on students' performance. A study of higher education in South Africa', *GATR Global Journal of Business and Social Sciences Review* 8(1), 41–49. https://doi.org/10.35609/gjbssr.2021.9.1(5)

Chinomona, R., 2011, 'Non mediated channel powers and relationship quality: A case of SMES in Zimbabwe channels of distribution', PhD dissertation, National Central University, pp. 1–175.

Choudhary, S., Nayak, R., Dora, M., Mishra, N. & Ghadge, A., 2019, 'SI-TBL: An integrated lean and green approach for improving sustainability performance: A case study of a packaging manufacturing SME in the U.K.', *Production Planning and Control* 30(5–6), 1–16.

Construction Health and Safety, 2007, *Regulations on environmental management of construction project, Government gazette*, pp. 1–38, Department of Labour, South Africa.

Cui, L., Chan, H.K., Zhou, Y., Dai, J. & Jia, J.L., 2019, 'Exploring critical factors of green business failure based on Grey-Decision Making Trial and Evaluation Laboratory (DEMATEL)', *Journal of Business Research* 98, 450–461. https://doi.org/10.1016/j.jbusres.2018.03.031

Debnath, S., 2018, 'Green IS – Information system framework to support environmental sustainability of firms', *International Journal of Business Information System* 1(2), 1–22.

Doll, W.J., Xia, W. & Torkzadeh, G., 1994, 'A confirmatory factor analysis of the end-user computing satisfaction instrument', *Management Information Systems Quarterly* 18(4), 357–369. https://doi.org/10.2307/249524

Ergen, M., 2021, 'Using geographical information systems to measure accessibility of green areas in the urban center of Nevşehir, Turkey', *Urban Forestry & Urban Greening* 62, 1–24. https://doi.org/10.1016/j.ufug.2021.127160

Fornell, C. & Larcker, D., 1981, 'Structural equation models with unobservable variables and measurement error', *Journal of Marketing Research* 18(1), 39–50. https://doi.org/10.1177/002224378101800104

Fraering, M. & Minor, M.S., 2006, *Sense of community: An exploratory study of United States*, Random House, New York, NY.

Gelzinis, G., 2021, *Addressing climate-related financial risk through bank capital requirements*, viewed 12 September 2021, from https://www.americanprogress.org/issues/economy/reports/2021/05/11/498976/addressing-climate-related-financial-risk-bank-capital-requirements/.

Hair, J.F., Babin, B.J., Anderson, R.E. & Tatham, R.L., 2010, *Multivariate data analysis. A global perspective*, 7th edn., Prentice-Hall, London.

Hashemi, S.E., 2021, 'A fuzzy multi-objective optimization model for a sustainable reverse logistics network design of municipal waste-collecting considering the reduction of emissions', *Journal of Cleaner Production* 318, 213–250. https://doi.org/10.1016/j.jclepro.2021.128577

Heil, F., 2018, *What is formal sector?*, viewed 29 August 2019, from https://www.quora.com/What-is-formal-sector.

Herrmann, F.F., Barbosa-Povoa, A.P., Butturi, M.A., Marinelli, S. & Sellitto, M.A., 2021, 'Green supply chain management: Conceptual framework and models for analysis', *Sustainability* 13(15), 1–20. https://doi.org/10.3390/su13158127

Huang, Y.C. & Yang, M., 2014, 'Reverse logistics innovation, institutional pressures and performance', *Management Research Review* 37(7), 615–664. https://doi.org/10.1108/MRR-03-2013-0069

Hulland, J., 1999, 'Use of partial least squares (PLS) in strategic management research: A review of four recent studies', *Strategic Management Journal* 20(2), 195–204. https://doi.org/10.1002/(SICI)1097-0266(199902)20:2<195::AID-SMJ13>3.0.CO;2-7

Jerzyk, E., 2016, 'Design and communication of ecological content on sustainable packaging in young consumers' opinions', *Journal of Food Products Marketing* 22(6), 627–636. https://doi.org/10.1080/10454446.2015.1121435

Khor, K.S., Udin, Z.M., Ramayah, T. & Hazen, B.T., 2016, 'Reverse logistics in Malaysia: The Contingent role of institutional pressure', *International Journal of Production Economics* 175, 1–39. https://doi.org/10.1016/j.ijpe.2016.01.020

Kukhnin, I. & Spiridonova, M., 2015, *Sustainability and Corporate Social Responsibility (CSR): Response to the challenges of the modern world*, viewed 03 September 2019, from https://www2.deloitte.com/ru/en/pages/risk/solutions/sustainability-and-csr.html.

Li, T. & Huang, Q., 2021, 'Green thermal power dispatching based on environmental information during the energy transition period', *Journal of Cleaner Production* 320, 1–22. https://doi.org/10.1016/j.jclepro.2021.128843

Li, Z., Sarwar, S. & Jin, T., 2021, 'Spatiotemporal evolution and improvement potential of agricultural eco-efficiency in Jiangsu Province', *Frontiers Energy Research* 9, 1–10. https://doi.org/10.3389/fenrg.2021.746405

Liu, J., Yuan, C., Hafeez, M. & Yuan, Q., 2018, 'The relationship between environment and logistics performance: Evidence from Asian countries', *Journal of Cleaner Production* 204, 1–30. https://doi.org/10.1016/j.jclepro.2018.08.310

Lu, W., Chi, B., Bao, Z. & Zetkulic, A., 2019, 'Evaluating the effects of green building on construction waste management: A comparative study of three green building rating systems', *Building and Environment* 155, 1–40. https://doi.org/10.1016/j.buildenv.2019.03.050

Mafini, C. & Loury-Okoumba, W.V., 2018, 'Extending green supply chain management activities to manufacturing small and medium enterprises in a developing economy', *South African Journal of Economic and Management Sciences* 21(1), 1–12. https://doi.org/10.4102/sajems.v21i1.1996

Magazzino, C., Adewale-Alola, A. & Schneider, N., 2021, 'The trilemma of innovation, logistics performance, and environmental quality in 25 topmost logistics countries: A quantile regression evidence', *Journal of Cleaner Production* 321, 1–20. https://doi.org/10.1016/j.jclepro.2021.129050

Mittal, R., 2021, *Sustainability in 2021: A construction industry perspective*, viewed 19 October 2021, from https://www.linkedin.com/pulse/sustainability-2021-construction-industry-perspective-rajeev-mittal.

Modise, D., 2018, *#BizTrends2018: Green building on the rise in South Africa*, viewed 02 August 2019, from https://www.bizcommunity.com/Article/196/720/171863.html.

Muhammad, D., Abdulrahman, A., Gunasekaran, A. & Subramanian, N., 2014, 'Critical barriers in implementing reverse logistics in the Chinese manufacturing sectors', *International Journal of Production Economics* 3(47), 460–471. https://doi.org/10.1016/j.ijpe.2012.08.003

Niroomand, I., 2017, *The importance of reverse logistics in your supply chain network*, viewed 02 October 2019, from https://blog.kinaxis.com/2017/09/importance-reverse-logistics-supply-chain-network/.

Okonkwo, P.N., 2019, *South Africa's construction industry could become safer. Here's how*, viewed 29 August 2019, from https://www.fin24.com/Opinion/south-africas-construction-industry-could-become-safer-heres-how-20190813.

Quinlan, C., Babin, B., Carr, J. & Griffin, M., 2019, *Business research methods*, 2nd edn., South Western Cengage, Andover.

Robinson, A., 2019, *9 benefits of effective reverse logistics process management & 5 advantages of partnering with a 3PL*, viewed 03 September 2019, from https://cerasis.com/reverse-logistics-process/.

Salhieh, L. & Abushaikha, I., 2016, 'Assessing the driving forces for greening business practices: Empirical evidence from the United Arab Emirates' logistics service industry', *South African Journal of Business Management* 47(4), 59–67. https://doi.org/10.4102/sajbm.v47i4.75

Sharma, N.K., Kumar, V., Verma, P. & Luthra, S., 2021, 'Sustainable reverse logistics practices and performance evaluation with fuzzy TOPSIS: A study on Indian retailers', *Cleaner Logistics and Supply Chain* 1, 1–18. https://doi.org/10.1016/j.clscn.2021.100007

Siziba, N., 2019, *Extortionist epidemic' on construction sites could cripple SA economy*, viewed 20 August 2019, from https://www.moneyweb.co.za/moneyweb-radio/extortionist-epidemic-on-construction-sites-could-cripple-sa-economy/.

Srivastav, P. & Gaur, M.K., 2015, 'Barriers to implement green supply chain management in small scale industry using interpretive structural modelling technique – A North Indian perspective', *Journal of Advances in Engineering and Technology* 2(2), 6–13.

Thaba, S.T., 2017, 'Drivers for reverse logistics in South Africa: A taxonomic literature review' *Proceedings of the World Congress on Engineering and Computer Science* 2, 1–8.

Trochim, W.M.K., 2020, *Research methods knowledge base*, viewed 22 February 2020, from https://socialresearchmethods.net/kb/descriptive-statistics/.

Tuan, L., 2018, 'Promoting logistics performance in Vietnam-based manufacturing firms: The role of service-oriented high-performance work systems and mediation mechanisms', *International Journal of Physical Distribution and Logistics Management* 49(1), 1–24. https://doi.org/10.1108/IJPDLM-07-2017-0238

Wang, W., 2021, 'The concept of sustainable construction project management in international practice', *Environmental Development Sustainability* 23, 16358–16380. https://doi.org/10.1007/s10668-021-01333-z

Wilcox, M., 2021, *5 sustainable packaging developments to watch in 2021*, viewed 10 July 2021, from https://www.greenbiz.com/article/5-sustainable-packaging-developments-watch-2021.

Wu, X., Zhao, W. & Ma, T., 2019, 'Improving the impact of green construction management on the quality of highway engineering projects', *Sustainability* 95(11), 1–24. https://doi.org/10.3390/su11071895

Xia, Y. & Yang, Y., 2018, 'The influence of number of categories and threshold values on fit indices in structural equation modeling with ordered categorical data', *Multivariate Behavioral Research* 1–16. https://doi.org/10.1080/00273171.2018.1480346

Yan, Y., Cheng, J., Wang, Y. & Li, Y., 2021, 'Does social trust stimulate regional eco-efficiency? Evidence from China', *Frontiers in Environmental Science* 9, 1–20. https:// doi.org/10.3389/fenvs.2021.700139

Yang, L. & Yang, Y., 2019, 'Evaluation of eco-efficiency in China from 1978 to 2016: Based on a modified ecological footprint model', *Science of the Total Environment* 66(2), 581–590. https://doi.org/10.1016/j.scitotenv.2019.01.225

Ye, F., Zhao, X., Prahinski, C. & Li, Y., 2013, 'The impact of institutional pressures, top managers' posture and reverse logistics on performance: Evidence from China', *International Journal of Production Economics* 143(1), 132–143. https://doi.org/10.1016/j.ijpe.2012.12.021