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Modelling Supply Chain Visibility: A Framework with Considerations for Manufacturing and Business

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Abstract

Purpose – Supply chain visibility plays a pivotal role in ensuring stakeholders have access to and share mutually beneficial information - information that is critical to processes, operations, and informed decision-making. This study leverages a framework to explore the influence of four key factors on supply chain visibility: supply chain linkages, supply chain relationships, green absorptive capacity, and information sharing.

Design/methodology/approach – This investigation adopted a survey-based research methodology to collect data. A sampling strategy was employed to recruit participants from various industry sectors, with a primary focus on manufacturing and business. A total of 204 usable questionnaires were obtained. Exploratory factor analysis (EFA) was conducted to identify underlying factors within the data. Confirmatory factor analysis (CFA) was then used to assess the validity and reliability of the identified factors. Finally, structural equation modelling (SEM) was employed to test the hypothesised relationships between the constructs studied.

Findings - This study's findings, particularly the significant positive correlations observed between information sharing, supply chain relationship strength, internal linkage, and green absorptive capacity, provide evidence that these factors are key drivers of supply chain visibility. Additionally, the analysis revealed that external linkages with supply chain partners further enhance information sharing within the chain.

Originality/value - This study offers a unique contribution by exploring the interplay between green absorptive capacity, information sharing, internal and external supply chain linkages, and their combined influence on supply chain visibility. Extending prior research that focused primarily on information sharing and traditional supply chain relationships, this study integrates green absorptive capacity and linkages within a novel framework. Our findings suggest that green absorptive capacity enhances information sharing within the supply chain network, ultimately leading to improved visibility. Furthermore, the study distinguishes the influence of internal vs. external linkages on visibility.

Keywords: Supply chain management, Sustainable production, SEM, Green Absorption Capacity, Visibility.

Paper type Research paper

Quick Value Overview

Interesting because:

Supply chain visibility is a cornerstone of competitive supply chains. Existing research recognises that visibility enhances collaboration, enhances decision-making, and supports transparency, traceability, and sustainability performance. However, there's a gap in understanding how factors like information sharing, supply chain relationships, internal and external linkages, and green absorptive capacity collectively interact to influence visibility. This study addresses this gap by proposing a novel framework that integrates these key constructs. By examining these factors together, we aim to provide a further understanding of how to achieve distinctive supply chain visibility.

Theoretical value:

This study contributes to the theoretical foundation of supply chain visibility by uncovering the impact of the factors studied. Our findings reinforce the importance of Natural Resource-Based View by highlighting the significance of green absorptive capacity as a valuable resource. Additionally, the study resonates with Information Processing Theory, demonstrating that effective information processing within a supply chain network relies heavily on strong internal and external linkages. Furthermore, by discerning the distinct roles of internal and external linkages, this study opens doors for further exploration of how different linkage types can influence visibility.

Practical value:

This study equips managers with actionable insights to enhance performance. Developing green absorptive capacity is important. This involves investments such as training and implementing systems to capture and share environmental best practices. Managers should also prioritise strengthening supply chain relationships and fostering internal and external linkages, e.g. through collaborative information-sharing platforms. By focusing on these areas and recognising the distinct roles of internal and external linkages, managers can achieve superior supply chain visibility.

1. Introduction

Supply chains (SC) is a network of entities in which individuals or organisations making up the entities use their resources in a series of activities to source, produce, make, store, and distribute goods to their customers. SCs are made up of systems of organisations, people, activities, information, and resources that operate as a network of entities offering and distributing goods and services. The recent growth of information and communication technologies and their integration into supply chains across manufacturing and service industries has given rise to several complex situations, resulting in increased competition within businesses arising from technological innovations and variations of consumer demands. Appropriate management of supply chains is important for businesses and organisations alike, particularly for those that operate globally and are subject to various competitive pressures from stakeholders.

Supply chain management (SCM) represents a conscious effort by which firms develop and run their operations efficiently and effectively. This allows enterprises to appropriately consider the coordination of all the various parts of their supply chain to support product and service quality and overall customer satisfaction. Supply chain managers often seek to adopt

new technologies, methods, and tools to improve their supply chain sustainability performance. Supply chain visibility (SCV) has been found to be an important consideration (Baah et al., 2022b).

SCV is the extent to which actors within a supply chain have access to, or share, information which they consider key or useful to their operations, improves decision-making, and is of mutual benefit to their operations (Barratt and Oke, 2007). SCV is considered a prerequisite for the effective management of supply chains for sustainable performance (Apeji et al., 2018). There are benefits to having supply chain visibility (e.g. Caridi et. al. 2014). The supply chain literature reports that visibility improves stakeholder collaboration and communication, reduces bullwhip effects and cost, increases product transparency and traceability, enhances responsiveness to sustainability issues, and improves sustainability awareness (e.g. Kamble et al., 2020). The benefits of visibility to sustainable supply chains cut across the three bottom lines of economic, environment and social sustainability, ranging from long-term corporate financial benefits to improved working conditions, environmental performance, and a continuous sustainable competitive advantage (Ortas et al., 2014). These benefits reinforce the crucial role of supply chain visibility in manufacturing across their supply chain processes, from raw-material sourcing to finished product delivery. Whilst SCV is an essential capability, manufacturing enterprises and businesses should be aware that the capability can be challenging to develop, especially to a distinctive level. Challenges include those associated with a) the sharing of quality information, b) availability, acquisition, and use of appropriate technologies, infrastructure and automation, c) people, process, cultural considerations and supply chain relationships, and d) absorptive capacity and governance.

Several studies consider the antecedents of SCV, examples of which can be found in (Barratt and Oke, 2007; Dubey et al., 2020, 2019; Lee et al., 2014; Nguyen et al., 2019). There is consensus in the literature that supply chain linkages, information sharing, and supply chain relationships are some of the key constructs regarding SCV. However, the relationship of some of these constructs and their impact on SCV, particularly concerning supply chain linkages, are

undeveloped. In manufacturing and business, supply chain linkages are the explicit and implicit connections a company has with others within its supply chain. This includes both external and internal connections. These linkages are crucial in manufacturing and businesses to facilitate SCV, amongst others. Additionally, there has been limited consideration of sustainability in previous studies of SCV and associated frameworks. An understanding of the influence on supply chain visibility of a substantive portfolio of key influencing factors, including sustainability constructs, is required. In summary, this paper focuses on the gaps in the literature regarding the impact of the blend of supply chain linkages, information sharing, and supply chain relationships alongside green absorptive capability that captures the ability of the supply chain to acquire, integrate, adapt, and exploit knowledge related to environmental sustainability. The research questions addressed in this paper are two-fold, as follows.

RQ1: What is the relationship between external and internal supply chain linkages on information sharing and visibility? and

RQ2: Put together, what is the impact of supply chain linkages (internal and external), supply chain relationships, and green absorptive capacity on information sharing and supply chain visibility?

By answering both RQ1 and RQ2, this study will make significant contributions regarding knowledge and understanding of supply chain visibility extended to sustainable environments. It will also contribute to how external and internal supply chain linkages are perceived to impact information sharing and visibility.

In summary, this paper investigates the influence of green absorptive capacity as a sustainability construct, along with supply chain linkages, supply chain relationships, and information sharing on supply chain visibility. These constructs are explained and developed in the next section. Section 2 contains the framework proposed in this paper and the associated

hypothesis. This is followed in Section 3 by the research methodology adopted and the measurement scale used in the study. Section 4 presents an evaluation of the framework, and the results are discussed in Section 5. Finally, Section 6 concludes the paper.

2. Theoretical background and hypothesis development

2.1 *Theoretical Background*

Previous studies have described supply chain visibility primarily from the resource-based view (RBV) (Barratt and Oke, 2007), emphasising the use of internal resources and opportunities to create unique and non-transferable assets. According to Wernerfelt (1995), RBV assumes that firms within an industry may be heterogeneous concerning the bundle of resources and capabilities they control. This vantage point has proven to be an influential theoretical framework for understanding how competitive advantage and firms' performance for visibility are achieved (Bartlett et al., 2007). According to the RBV perspective, core competencies, dynamic capabilities, and firm capacity are prioritised. Firms that master these, combined with a unique resource mix, are likely to attain long-term competitive advantages over competitors (Cao and Zhang, 2011). According to Barney (2012), firms that excel in core competencies, capabilities, and strategic resources will likely experience more significant outputs.

RBV emphasises that due to their unique, valuable, non-imitable, and non-substitutable nature, firms that form collaborative partnerships and alliances can lead to the development of competitive advantage (Barney, 2012). Absorptive Capacity (AC) relates to a firm's capability to identify, assimilate, and apply external information to develop unique skills and competencies to achieve economies of scale (Cao and Zhang, 2011; Dyer and Singh, 1998). Furthermore, resources and competencies serve as a foundation for a company's strategy (Grant, 1991). Consequently, organisations are challenged to develop resources and capabilities efficiently to support their decision-making processes. Organisations may enhance

their business operations, gain efficiency, and achieve SCV by properly managing resources and capacities (Saqib and Zhang, 2021).

Associated with RBV is the relational view theory (RV). In the context of supply chains, while RBV focuses on actions taken to manage resources and capacities of the supply chain, relational view theory (RV) emphasises the interaction between two or more supply chain partners. Dyer and Singh (1998) suggest that idiosyncratic inter-organisational relationships can lead to long-term competitive advantage. It has been claimed that stronger ties and partner investment in inter-firm knowledge-sharing routines and relation-specific assets might provide a competitive advantage and should be considered a winning strategy. RV sheds light on how a company builds value-creating partnerships with other companies to maximise profits (Lee et al., 2014). When applied to SCV, the relational approach implies that a firm's collaborative ties with stakeholders can generate relational rents through relation-specific assets, knowledge-sharing routines, complementary resource endowments, and good governance (Baah et al., 2022b). These actions form a collaborative connection that is difficult for competitors to mimic and can give well-executed supply chain strategies competitive advantages and supernormal rents.

Natural resource-based view (NRBV) emerged from an earlier theoretical contribution of the RBV (Hart and Dowell, 2011), and its primary focus is on natural (biophysical) resources. NRBV proposes a dynamic and interconnected view of resources in which resource transferability is no longer considered a concern but rather a requirement (Barney, 2012). Environmental and social issues can be used to obtain a competitive advantage and addressed to enhance efficiency and differentiation. This is reinforced by supply chain managers' increasing motivation to meet environmental and social obligations. From this perspective, the NRBV promotes the absorptive capacity intended to change supply chains by seeking new

knowledge. It moderates the relationship between environmental and organisational factors (Fulgence et al., 2022).

2.2 *Hypothesis development*

The study is based on the hypothesis and associated conceptual framework developed in the sections below.

2.2.1 Information Sharing and Visibility

In the context of supply chains, organisations recognise the collaborative nature of their activities, involving multiple stakeholders with diverse preferences working together to meet customer needs. Effective decision-making processes require sharing quality information that is quick, reliable, and accurate. Information sharing (IS) has emerged as a critical aspect of integrating and continuously optimising supply chains (Fawcett et al., 2007), allowing stakeholders to see end to end of their supply chains more clearly. Supply chains have been imagined as the distribution of meaningful information among systems, individuals, or organisational units (Kembro et al., 2017).

Information sharing occurs at different organisational levels within a supply chain: operational, tactical, and strategic. Each level represents a specific decision time horizon for which the shared information is intended. At the operational level, sharing information such as order details, inventory status, and sales data can reduce information distortion, facilitate efficient order processing, and minimise overall stock levels and costs. On the tactical level, the exchange of monthly and quarterly forecasts enables better predictions, reduces bottleneck activities, and enhances the quality of customer services (Kembro et al., 2017). At the strategic level, sharing information such as annual demand, marketing strategies, promotions, and sales can foster the development of social bonds, expand the network, and improve resource utilisation (Burt and Soda, 2021).

The ability of stakeholders to access critical performance indicators and process data provides them with a broader perspective and visibility on the issue at hand. It enables them to consider important factors when making decisions. The capacity to make informed decisions based on enhanced visibility underscores the significance of information sharing among supply chain members (Williams et al., 2013). Information sharing facilitates decision synchronicity and enables participating members to fulfil their demands quickly, reducing the order cycle time (Ganbold et al., 2020).

The essential role of information sharing (IS) in enhancing supply chain visibility (SCV) has been recognised very early in the literature. The integration of information flow within a complex and dynamic business environment is considered the critical factor enabling visibility in supply chains (Goswami et al., 2013). By leveraging existing information, making it accessible to various stakeholders and mutually beneficial, firms can comprehend market variations and effectively address flexible customer demands. Access to relevant, timely, and accurate information empowers supply chain members to respond to various events promptly, thereby enhancing visibility (Wang et al., 2016). The quality of shared information is critical in achieving and improving desirable visibility levels. Furthermore, information sharing is a core operational activity in supply chain operations, and its potential for enhancing visibility contributes to a more successful supply chain (Barratt and Oke, 2007). From the foregoing, there is little or no question regarding the impact of information sharing on supply chain visibility. This role can be further substantiated by validating the current evidence regarding the relationship. Corroborating the above, it is hereby hypothesised that:

H1: Information sharing has positive and significant impact on supply chain visibility.

2.2.2 Linkages, Information Sharing, and Visibility

In today's business environment, firms need to understand better the importance of developing linkages with their suppliers and customers due to, for example, the emergence of more advanced and distributed manufacturing technologies, processes, and systems. Firms are realising the role of interconnections between their internal organisational functions and those of their suppliers and consumers (Marra et al., 2016; Nguyen et al., 2021). Information systems backed by advances in digital technology have seen a growing need to create linkages based on the exchange of information to manage the flow and quality of inputs from suppliers to the firm, and outputs from the firm to customers (Kimitei et al., 2015). In addition, many firms have used their competencies and resources to improve their supply chain network by developing seamlessly coordinated linkages. Linkages can be causal (sequentially or non-sequentially) or interdependent (Okongwu et al., 2015).

Supply chain management seeks improved performance by effectively using resources and capabilities via the development of internal and external linkages to create a seamlessly coordinated supply chain. These linkages can provide a close-knit network, which could help the firms gain a competitive advantage and improve performance. Linkages enable the sharing of information between various actors in the supply chain (Kimitei et al., 2015); they are created by implementing practices that include, for example, the involvement of suppliers and customers in product and process design activities and investment in systems to allow information sharing across the supply chain to gain accessibility to customer's and suppliers' operations and activities.

It has been argued that closer information-based linkages should be encouraged and built to achieve end-to-end visibility within a supply chain network, which could be vital for effective supply chain management (Ibrahim and Ogunyemi, 2012). Linkages can be categorised into

internal and external linkages. Internal linkages are the explicit and implicit connections between various stakeholders internal to a firm. One purpose of creating internal linkages is to enhance information sharing within a firm supply chain, leading to improved operational performance. This can help minimise conflict and misinterpretation while facilitating the flow of information among the various functions within the supply chain to fulfil customers' orders promptly (Nguyen et al., 2019). External linkages represent the explicit and implicit connections between various stakeholders outside the firm and are critical for improving supply chain performance (Marra et al., 2016). External linkages can determine the level and quality of shared information and are often categorised into customer and supplier linkages. A firm that appropriately involves its suppliers and customers in the decision-making process of its supply chain would reduce demand uncertainty, improve its services to meet customer needs, and lower inventory holding and monitoring costs (Rungtusanatham et al., 2003). For example, Carter and Ellram (1994) reported that a firm that involves its suppliers in its product design process would reduce the product defect rate across the supply chain. Overall, evidence suggests that supply chain linkages do influence information sharing and visibility. However, the influence of external versus internal supply chain linkages on information sharing and supply chain visibility is less clear. Corroborating the above argument and evidence, it is hereby hypothesised that:

H2: External linkage has positive and significant impact on information sharing,

H3: External linkage has positive and significant impact on supply chain visibility,

H4: Internal linkage has positive and significant impact on information sharing,

H5: Internal linkage has positive and significant impact on supply chain visibility,

2.2.3 Supply chain relationship, information sharing, and visibility.

In today's competitive environment, supply chain relationships (SCR) vary significantly across different sectors. Nowadays, companies have been encouraged to develop close relationships with suppliers and customers as they play a significant role in managing supply chains (Dutta, 2012). Specific dimensions of relationships, networks and transactions are key antecedents of information sharing. SCR is a strategic alliance between two or more stakeholders that allows for the easy exchange of information, demand data, and status visibility in one or more core value-creating activities, such as product development, manufacturing, marketing, sales, and distribution. The purpose of SCR is to enhance the strategic and operational capabilities of stakeholders to achieve long-term benefits. SCR can help maximise opportunities for stakeholders by lowering total costs of operation, improving transparency, and facilitating the distribution of goods and services (Rogers and Fells, 2017). As a result, the supply chain relationship across all supply chain partners can impact visibility and on-time delivery (Lee et al., 2014). According to Williams et al. (2013), firms with greater visibility, i.e., enterprises with high consumer and supplier recognition, will face increased pressure to make good decisions.

There is evidence that supplier relationships influence information sharing and visibility. Park (2017) argues that SCR strongly predicts information sharing. Supply chain visibility relies on the ability of stakeholders and partners to share quality information, which is derived from trust and commitment among members. Having a working relationship improves the quality of information shared, as supply chain partners are encouraged to commit to the long-term strategy of the organisations (Chen et al., 2011). Supply chain relationships are key determinants in achieving innovation, resilience, and a drive toward sustainability awareness.

The outcome improves as each supply chain partner becomes more willing to share and learn from one another (Knoppen et al., 2015). It is hypothesised that:

H6: Supply chain relationship has positive and significant impact on information sharing,

H7: Supply chain relationship has positive and significant impact on supply chain visibility,

2.2.4 Green absorptive capacity, information sharing, and visibility.

An inward-looking approach to organisations that depend solely on their information and resources is insufficient, as they need knowledge from different sources and fields. In a dynamic business environment, knowledge is a key capability for developing an organisation's supply chain, creating value, and sustaining competitive advantages. Organisations must be aware of existing knowledge and technological developments to absorb information from various sources. Also, organisations must have the competencies to understand, decode, assimilate, and utilise these ideas. This would enable them to understand and implement the ideas and concepts of others (Li and Zhang, 2015).

Green absorptive capacity (GAC) relates to an organisational capability to obtain, integrate, convert, utilise, and apply information and environmental knowledge for commercial use (Song et al., 2020). In the context of environmentally conscious supply chains, GAC can be seen as the ability of a company to apply its existing resources, information, and knowledge to renew and create its organisational capabilities to respond to the dynamic market as it relates to the environment, economy, and society (Qu et al., 2022). The capability derived from integrating green absorptive capacity into the firm can be considered a critical determinant for competitive advantage. Whilst the role of absorptive capacity on supply chain visibility has been alluded to in the literature, the influence of green absorptive capacity, alongside constructs such as supply chain linkages and supply chain relationships, on supply chain visibility is unclear. According

to Sadeghi et al. (2023), absorptive capacity enhances firm visibility by lowering the cost of valuing and assimilating internal and external information and knowledge available to the firm. GAC would imply that the more firms use their knowledge related to the environment, society, and the economy, the better they can deal with issues arising from green technology, climate change, resource efficiency, waste reduction and variations in the market. Increasingly, firms are required to be aware of information, assimilate new knowledge through learning, share information appropriately, and improve their supply chain visibility levels for competitive advantage. Corroborating the above argument and evidence, it is hereby hypothesised that:

H8: Green absorptive capacity has positive and significant impact on information sharing,

H9: Green absorptive capacity has positive and significant impact on supply chain visibility.

2.3 The conceptual framework

The proposed conceptual framework shown in Figure 1 provides a hypothesised view of how visibility can be influenced in a supply chain, including within sustainable environments. Informational linkages consisting of internal and external linkages (Barratt and Barratt, 2011; Barratt and Oke, 2007; Zelbst et al., 2009), green absorption capacity (Chen et al., 2015), supply chain relationship (Kimitei et al., 2015), and information sharing are hypothesised to influence supply chain visibility.

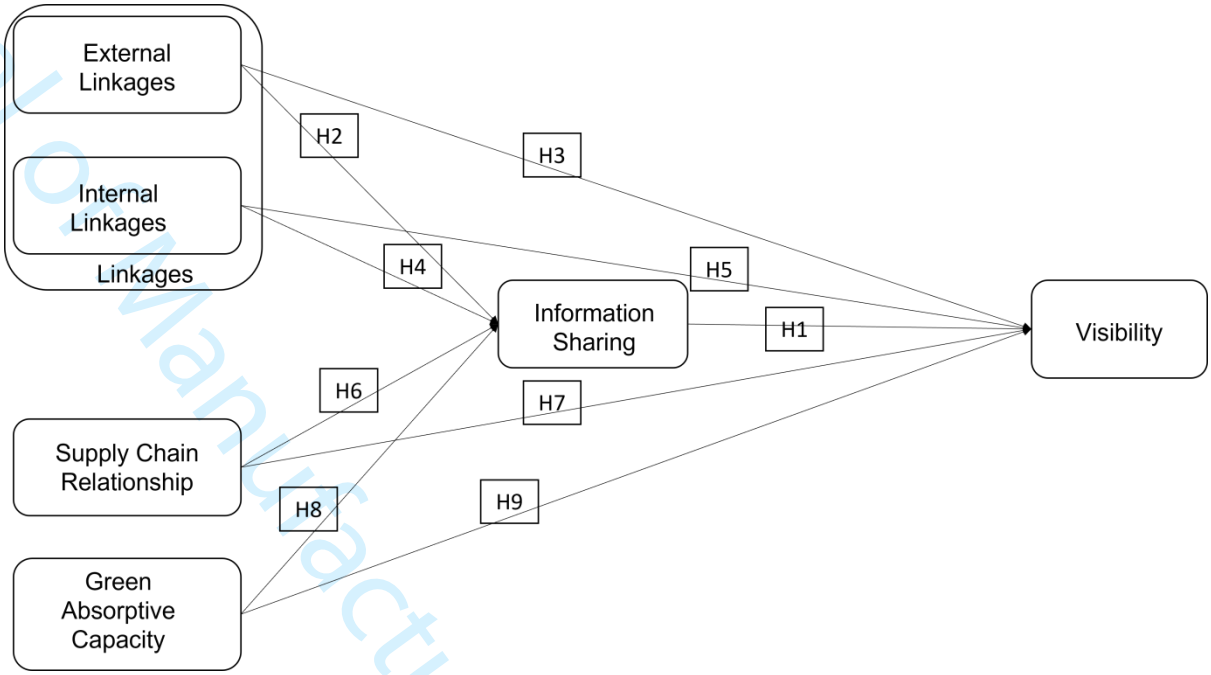

Figure 1: Conceptual Framework

3. Methodology

The conceptual framework developed in Section 2, Figure 1, is evaluated using data from a structured questionnaire survey. The constructs of the framework are operationalised in Section 3.1. The sampling method and approach to data collection are described in Section 3.2.

3.1 Operationalisation of constructs.

In operationalising the conceptual framework's construct, measurement scales used in previous research within the supply chain literature are adopted in this study. Using scales from previous research should enhance the validity and reliability of the findings (Mellinger and Hanson, 2021). All the constructs in this study were measured using three or more items as recommended by (Cronbach and Meehl, 1955; Hair et al., 2019). The constructs were operationalised using the Likert scale (1-7), where (1) signifies "strongly disagree" and (7) signifies "strongly agree". In addition to questions relating to the constructs, general information about the respondents' demographics and supply chain organisation was collected.

The questionnaire was pre-tested by a panel of (a) eight sustainable supply chain management professionals, who on average have fifteen years of industrial experience, and (b) five academics in higher institutions who are specialists in supply chain management at senior or higher positions. Pre-testing the questionnaire helps validate the constructs' structure and relevancy (Golafshani, 2015). The panel suggested minor changes that helped improve the overall structure of the questionnaire. The questionnaire items adopted are shown in Table 1.

TABLE 1: Questionnaire items

External linkages (Barratt and Oke, 2007)	
EL 1	Our company interacts with customers to forecast demand.
EL 2	Our company involves suppliers during the design stage for our new products.
EL 3	Our company involves suppliers in production planning and inventory management.
EL 4	Our company has a supplier network that assures reliable delivery.
Internal linkages (Barratt and Barratt, 2011)	
IL 1	Our company has an integrated database for production, logistics, distribution, and vendor information.
IL 2	Our company has easy access to key operational data in this integrated database.
IL 3	Our company utilises a computer-based planning system between sales and production.
IL 4	Our company has a high degree of information system integration for production processes.
Green absorption capacity (Chen et al., 2015)	
GAC 1	Our company can communicate green knowledge across its divisions.
GAC 2	Our company can identify, obtain, and value external green knowledge, which is crucial to its operations (reduction of waste).
GAC 3	Our company can effectively apply new external green knowledge for commercial purposes (Increased productivity).
GAC 4	Our company can integrate existing green knowledge with newly obtained and incorporated green knowledge.
GAC 5	Our company's structure facilitates the development and ability to analyse, comprehend, and deduce information from external green knowledge.
Information sharing (Khan et al., 2016),.	
IS 1	Our company regularly share information.
IS 2	Our company exchanges relevant information with our partners.
IS 3	Our company exchanges timely information with our partners.
IS 4	Our company exchanges accurate information with our partners.
IS 5	Our company exchanges complete information with our partners.
Supply chain relationship (Maghsoudi and Pazirandeh, 2016).	
SCR 1	We are committed to our major Supply Chain partners.
SCR 2	Considerable effort and investment have been undertaken to build this relationship.
SCR 3	Our major Supply Chain partner has high integrity.
SCR 4	Both parties are willing to make mutual adaptations.
Visibility (Barratt and Oke, 2007)	
V 1	Our key suppliers share with us the information regarding their process issues in a timely manner.
V 2	The strategic information we have about our key suppliers is up to date.
V 3	The strategic information we have about our key supplier is relevant to our business.

3.2 Sampling and data collection

The study data were collected from supply chain managers. Participation was not limited to a particular sector; the questionnaire was distributed to potential industry respondents randomly sourced from the Federal Ministry of Industry Trade and Investment in Nigeria and the Datantify directories.

600 questionnaires were sent out, and 206 questionnaires were returned. Two of the returned questionnaires were partially completed. As a result, a total of 204 useful questionnaires were obtained, achieving a response rate of 34%. This aligns with suggestions that an average response rate to an online survey would be about 33 percent (Nulty, 2008). Furthermore, the sample size of 204 questionnaires is within the range of 150 to 400 recommended for the structural equation modelling (SEM) method used for data analysis in this study (Hair et al., 2010).

Analysis was conducted to test for data adequacy and non-response bias. A T-test was conducted to verify any substantial variance between early and late responses, as suggested by (Mentzer and Lambert, 2015), to ensure the generalizability of the findings to the population (Lindner et al., 2001). The T-test showed no significant statistical differences between the early and late responses ($p < 0.05$). This gives evidence that the valid questionnaires represent an unbiased response.

The guidelines suggested by (Conway and Lance, 2010) and (Jordan and Troth, 2020) to address common method bias were followed. The pre-test also helps in reducing possible item characteristic effects as a source of common method bias (Podsakoff et al., 2003). Respondents' familiarity with the items and variables is not of concern because they are supply chain management professionals. Harman's one-factor test was conducted to test for a potential

common method bias. If a single factor or one "general" factor accounts for most of the total variance, common method bias can be a concern (Podsakoff et al., 2003). Using the Maximum likelihood estimation in the statistical package for social sciences (SPSS), the findings of Harman's test revealed that the largest factor, among several factors that emerged, accounts for only 45.4% (< 50%) of the total covariance among all measures.

4 Results and analysis

Table 2 shows the profile of respondents. The majority of the respondents come from a manufacturing and engineering background and work with multiple suppliers and customers. Most of the respondents have good experience in supply chains and sustainability.

TABLE 2. Profile of respondents

Characteristics	Value	Frequency	Percentage (%)
Experience	[< 5years]	5	2.5
	[5 – 10 years]	55	27.5
	[10 – 15 years]	87	43.5
	[15 – 20 years]	43	21.5
	[> 20 years]	10	5
Business/Organisation type	Financial service	2	1
	Automotive industry	26	13
	Construction	9	4.5
	IT-Technology	5	2.5
	Electrical industry	4	2
	Manufacturing	71	35.5
	Service industry	52	26
	Telecommunication	1	0.5
	Mechanical industry	11	5.5
	Retail	19	9.5
Size of organisation	[< 20]	5	2.5
	[20 – 50]	3	1.5
	[51 – 100]	3	1.5
	[101 – 200]	13	6.6
	[201 – 500]	73	36.9
	[501 – 1000]	88	44.4
	[> 1000]	13	6.6
Relationships	Single Supplier Only	1	0.5
	Single customer only	1	0.5
	Multiple Suppliers/Customer	196	98
Experience in supply chain and sustainability	[0 years]	1	0.5
	[1 – 4 years]	50	2.5
	[5 – 10 years]	121	60.5

	[11- 15 years] [16 – 20 years] [> 20 years]	21 0 7	10.5 0 3.5

4.1 Analysis and Results of Factor Analysis

Two main procedures are involved in the factor analysis conducted: Exploratory factor analysis (EFA) and Confirmatory Factor Analysis (CFA) (Hair et al., 2010). The EFA is conducted using the factor analysis tool in SPSS 27.0 and CFA was performed using the AMOS programme version 27.0.

Exploratory factor analysis (EFA) was used to test the one-dimensionality of the items. The EFA with principal component analysis (PCA) was performed using Promax with Kaiser normalisation rotation method. The factor loadings converged in 6 iterations (Weide and Beauducel, 2019). The results of the EFA are shown in Table 3. The Kaiser-Meyer-Olkin (KMO) obtained from the EFA is higher than the minimum value of 0.70 recommended by (Kaiser, 1974). The total variance explained, which is 71.9%, exceeds the recommended threshold value of 60% (Hair et al., 2010). All the measurement items have loadings above the 0.50 threshold on the constructs they measure, which is adequate for this study. Hair et al. (2019) suggests that factor loadings above 0.40 are adequate for an explorative study.

TABLE 3: EFA of the measurement items

Constructs	Items	Loadings	AVE	CR	Cronbach's α
Supply Chain Relationship (SCR)	SCR1	0.724	0.564	0.837	0.834
	SCR2	0.672			
	SCR3	0.877			
	SCR4	0.766			
Internal Linkages (IL)	IL1	0.812	0.579	0.846	0.844
	IL2	0.751			
	IL3	0.762			
	IL4	0.705			
Green Absorptive Capacity (GAC)	GAC1	0.814	0.633	0.896	0.895
	GAC2	0.783			
	GAC3	0.816			
	GAC4	0.774			
	GAC5	0.835			

Information Sharing (IS)	IS1	0.747	0.647	0.902	0.901
	IS2	0.819			
	IS3	0.903			
	IS4	0.831			
	IS5	0.733			
External Linkages (EL)	EL1	0.531	0.586	0.835	0.850
	EL2	0.699			
	EL3	0.937			
	EL4	0.786			
Visibility (V)	V1	0.711	0.638	0.841	0.837
	V2	0.853			
	V3	0.784			
Total variance explained (%)	71.940				
KMO	0.936				

Note SCR, supply chain relationship; IL, Internal linkages; GAC, green absorptive capacity; IS, information sharing; EL, external linkages; V, Visibility.

4.2 Reliability and Validity

Reliability and validity tests were conducted using confirmatory factor analysis (CFA) in SPSS 27.0. CFA was also used to test the one-dimensionality of the constructs. The fit of the overall measurement model was tested using Amos 27.0 (Blunch, 2017). The model fit indices demonstrated good levels, CMIN/DF = 1.756, CFI = 1.000, SRMR = 0.050, RMSEA = 0.060, and PClose = 0.024. Cronbach's α and composite reliability (CR) were used to test reliability. If the CA value is greater than 0.60 (Taber, 2018), the CR value is greater than 0.70 (Hair et al., 2010), which is the case in this study; reliability is acceptable. Validity is measured by convergent and discriminant validity; convergence validity is ensured if the standardised factor loading is greater than 0.50 and the average variance extracted (AVE) value is higher than 0.50, which is the case in this study. Finally, the scale has discriminant validity if the AVE value is greater than the correlation coefficients square, which is also the case in this study (Ab Hamid et al., 2017). The reliability and validity results are shown in Table 4.

TABLE 4: Discriminant validity

	GAC	IS	SCR	EL	IL	V
Green absorptive Capacity (GAC)	0.796					
Information Sharing (IS)	0.717***	**0.804**				
Supply chain Relationship (SCR)	0.586***	0.747***	**0.751**			
External Linkages (EL)	0.724***	0.740***	0.545***	**0.765**		
Internal linkages (IL)	0.737***	0.752***	0.651***	0.687***	**0.761**	
Visibility (V)	0.716***	0.746***	0.670***	0.665***	0.742***	**0.799**

Significance of Correlations: † p < 0.100, * p < 0.050, ** p < 0.010, *** p < 0.001

HTMT, proposed by (Henseler and Schuberth, 2020) was used to examine the discriminant validity of the model. The HTMT ratios (0.591 - 0.756) of SCR, IL, GAC, IS, EL, and V shown in Table 5 show that the model has achieved discriminant validity since the values are < 0.85 thresholds suggested by (Henseler and Schuberth, 2020).

TABLE 5: DISCRIMINANT VALIDITY (HETEROTRAIT–MONOTRAIT RATIO (HTMT)

	GAC	IS	SCR	EL	IL	V
Green absorptive Capacity (GAC)						
Information Sharing (IS)	**0.710**					
Supply chain Relationship (SCR)	0.591	**0.745**				
External Linkages (EL)	0.727	0.733	**0.569**			
Internal linkages (IL)	0.741	0.756	0.662	**0.697**		
Visibility (V)	0.722	0.753	0.693	0.674	**0.741**	

The model fit is determined based on the following criteria: Comparative Fit Index (CFI), minimum discrepancy divided by its degree of freedom (CMIN/DF), p-value for rejecting the null hypothesis that the model fits the individual subject's data (PClose), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). Thresholds for the model fit measures have been reported (e.g. Hu and Bentler, 1999; Henseler and Sarstedt, 2013). A value of CFI ≥ 0.95 is recognised as indicative of a good model fit, and a CFI value greater than 0.90 is considered acceptable. A CMIN/DF value of less than two is considered a good fit, whereas a value of less than 5 refers to an acceptable fit. A PCLOSE value less than 0.05 indicates that RMSEA is greater than zero, and therefore, the model does

not fit. An RMSEA value of 0.08 or less indicates an acceptable fit and a value of 0.05 or less indicates a perfect fit. The value of SRMR must be lower than the threshold value of 0.1. Table 6 contains the results of model fit in this study. The recorded values indicate model fit.

Table 6: Model Fit Indices

Measure	Estimate	Threshold	Interpretation
CFI	0.922	>0.9	Acceptable
CMIN/DF	1.701	Between 1 and 3	Excellent
PClose	0.016	>0.05	Acceptable
RMSEA	0.059	<0.06	Excellent
SRMR	0.050	<0.08	Excellent

4.3 Test for hypotheses.

Before testing the proposed relationships, multicollinearity was tested. From the data, the largest variance inflation factors (VIF) value is 2.663, which indicates that multicollinearity is not a concern as the VIF value is < 3, as recommended by (Ringle and Sarstedt, 2016). The structural model was further evaluated by examining the variance explained by exogenous variables (R2), along with the model's predictive relevance using path coefficients (β) and significance levels (p-values). The R^2 value of 0.552 predicts sustainable supply chain visibility from IL, EL, SCR, GAC, and IS constructs, indicating that the model accounts for 55.2% of the variance in supply chain visibility. Similarly, IL, EL, SCR, and GAC explain 62.4% of the variance in information sharing (R^2 – 0.624). Table 7 summarises the results of the hypothesis tests, while Figure 2 illustrates the standardised path coefficients and the outcomes of the hypothesis tests.

Table 7 Summary of hypotheses test results.

Hypotheses	Coefficient (β)	T statistics	P values	Inner VIFs	Supported
H1: Information sharing positively influences visibility.	0.232	2.741	0.007	2.663	Yes
H2: External linkages positively influence information sharing.	0.213	4.059	0.000	1.878	Yes
H3: External linkages positively influence visibility.	0.095	1.458	0.147	2.036	No
H4: Internal linkages positively influence information sharing.	0.238	3.659	0.000	2.071	Yes
H5: Internal linkages positively influence visibility.	0.213	2.680	0.008	2.212	Yes
H6: Supply chain relationship positively influences information sharing.	0.336	5.710	0.000	1.565	Yes
H7: Supply chain relationship positively influences visibility.	0.206	2.733	0.007	1.826	Yes
H8: Green absorptive capacity positively influences information sharing.	0.171	2.786	0.006	2.119	Yes
H9: Green absorptive capacity positively influences visibility.	0.220	2.976	0.003	2.202	Yes

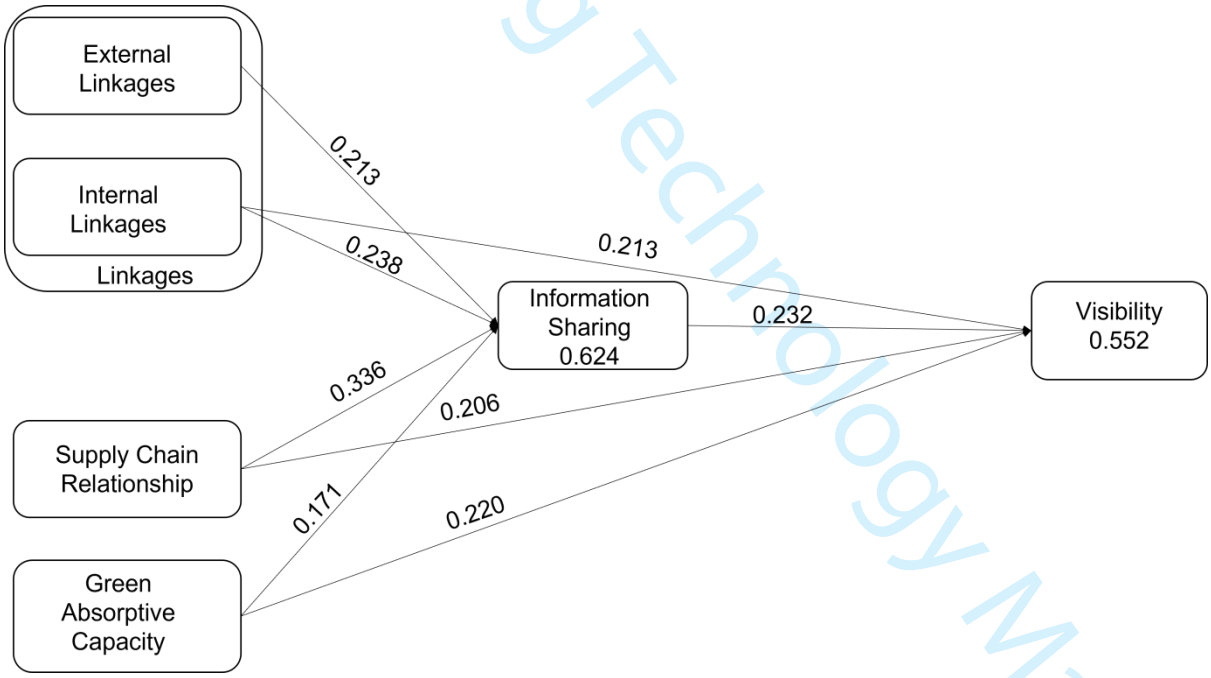

Figure 2: Research model and hypothesis.

The results presented in Table 7 shed light on the relationships between different variables and their impact on supply chain visibility. Firstly, Hypothesis 1 proposed that a firm's sharing of

quality information with its partners would positively and significantly influence supply chain visibility. The results support this hypothesis (β = 0.232, p = 0.007), indicating that effective information-sharing practices positively impact supply chain visibility. This finding highlights the importance of sharing relevant and accurate information with internal and external stakeholders to enhance supply chain visibility. It suggests that organisations should prioritise information sharing to improve overall supply chain performance.

Hypothesis 2 suggested that external linkages would positively influence the level and quality of information sharing. The analysis supports this hypothesis (β = 0.213, p = 0.000), indicating that establishing connections and collaborations with external stakeholders significantly facilitate information-sharing practices. According to Nguyen et al. (2021), external linkages provide a platform for sharing knowledge related to sustainability awareness and environmental practices. This finding emphasises the importance of building strong relationships with external partners to enhance information sharing and promote sustainable supply chain practices.

However, it is worth noting that Hypothesis 3, which proposed a positive relationship between external linkages and supply chain visibility, was not supported (β = 0.095, p = 0.147). This result suggests that while external linkages contribute to information sharing, they may not directly impact supply chain visibility. Further investigation is needed to understand the underlying factors that influence supply chain visibility and the complex dynamics between external linkages and visibility outcomes.

Hypotheses 4 and 5 examine the relationships between internal linkages, information sharing, and supply chain visibility, and the analysis supports both hypotheses. The results demonstrate a positive relationship between internal linkages and information sharing (β = 0.238, p = 0.000) and between internal linkages and supply chain visibility (β = 0.213, p = 0.008). This finding

highlights the significance of strong internal collaborations and communication within the organisation. When internal stakeholders are connected and effectively sharing information, it improves visibility across the supply chain (Barratt and Oke, 2007). Organisations should foster internal linkages and promote a collaborative culture to enhance information sharing and achieve higher levels of visibility in their supply chain.

Hypotheses 6 and 7 explored the relationships between supply chain relationships (SCR), information sharing, and supply chain visibility. The analysis supports both hypotheses, indicating that SCR positively influences information sharing ($\beta = 0.336$, $p = 0.000$) and supply chain visibility ($\beta = 0.206$, $p = 0.007$). These findings emphasise the importance of collaboration, cooperation, and communication among supply chain partners (Maghsoudi and Pazirandeh, 2016). By establishing strong relationships and ensuring effective information sharing, organisations can build trust and commitment, improving visibility across the supply chain. This supports previous research and highlights the significance of stakeholder integration practices in achieving higher levels of visibility in their supply chain.

The analysis supports Hypotheses 8 and 9, indicating that GAC positively influences information sharing ($\beta = 0.171$, $p = 0.006$) and, in turn, supply chain visibility ($\beta = 0.220$, $p = 0.003$). By fostering GAC, organisations can promote the exchange of relevant and beneficial green information, leading to improved supply chain visibility and sustainability performance.

5 Discussion and Implications

Linkages are commonly believed to have a positive relationship with supply chain visibility and that the relationship operates through information sharing (e.g. Barratt and Oke, 2007, Barratt and Barratt, 2011). This research highlights an important distinction between external and internal linkages and their impact on visibility. Internal linkages have a positive relationship with information sharing and supply chain visibility thus fostering strong

collaboration and communication within an organisation can enhance information sharing and improve visibility across the supply chain. On the other hand, external linkages do not necessarily exhibit a direct positive relationship with supply chain visibility. This finding aligns with the arguments such as Williams et al. (2013); increasing the number of external linkages does not necessarily result in greater visibility. The complexity of the supply chain can lead to information overload, making it challenging to extract relevant information for decision-making. The bombardment of data from external sources can lead to confusion and a lack of coordination among supply chain partners, ultimately reducing visibility. Additionally, external linkages can pose challenges in verifying the accuracy and reliability of the information, leading to hesitancy in relying on externally sourced information and diminishing the effectiveness of these linkages in improving supply chain visibility (Klueber and O'Keefe, 2013). Overall, information sharing is crucial for good decision-making, collaboration, organisation learning, enables risk sharing and mitigation, improves knowledge sharing, resource control and sustainability. It can help identify opportunities to reduce waste, improve energy efficiency, and promote sustainable practices throughout the supply chain (Gurzawska, 2019). Companies should prioritize "green" practices (green absorptive capacity) to improve visibility. Sharing information on sustainability strengthens partnerships and visibility. Overall, strong relationships, information sharing, and green practices work together to enhance supply chain visibility.

Finally, visibility plays a crucial role in effective and efficient interconnections between enterprises and their supply chains, enhancing collaborative efforts among supply chain partners and other stakeholders. This study emphasises that information sharing is critical for establishing and improving supply chain visibility. Essentially, disseminating relevant, meaningful and useful information to increase visibility should be prioritised. While information sharing has a positive impact on visibility, it is equally important to recognise that

building stakeholder trust through linkages and relationships can also contribute to visibility enhancement. Consequently, in this study, sharing information and supply chain visibility through appropriate linkages, relationships, and green absorptive capacity with associated technologies can create win-win scenarios for businesses. This study resonates with Information Processing Theory (Galbraith, 1973), reinforcing the view that effective information processing within a supply chain network relies heavily on strong internal and external linkages. Manufacturing and businesses with useful supply chain information processing capabilities are better placed to meet their information needs regarding their stakeholders.

This study has implications for manufacturing and businesses. The study findings offer actionable insights for supply chain managers and associated practitioners, identifying key factors—information sharing, internal linkages, external linkages, and green absorptive capacity—as influencers of supply chain visibility. It reinforces to managers the significance of information sharing in driving supply chain visibility and the fact that resources should be accounted for. Ability to prioritise visibility influencing factors for competitive advantage and resilience is imperative (e.g. Sunmola et. al. 2023). In their study using data collected from UK manufacturing plants, Brandon-Jones et al. (2014) found that information-sharing resources and supply chain connectivity enhance supply chain resilience and robustness in the face of disruptions. Managers can leverage these insights to enhance their strategies and improve relationships and collaboration. From a resource-based view, implicit in the findings are resources and the associated required investments.

The study findings indicate that internal and external linkages may play different roles in manufacturing and businesses. As a result, organisations may need to appropriately optimise their investments in developing supply chain linkages whilst recognising the roles these linkages play in impacting information sharing and supply chain visibility. Implementing these

findings can lead to more efficient supply chain operations, reduced risks, increased resilient, and potential economic benefits for organisations. While the primary focus of this study is on managerial and operational implications, the broader societal impact can be discerned through the promotion of green absorptive capacity in the development of information sharing and supply chain visibility capability. Manufacturing and businesses need to recognise that their journey towards achieving a distinctive visibility level in their supply chain as a competitive advantage in sustainable environments will increasingly require investments in green absorptive capacity. This implies the need for managers to support the development of information technology competencies, as they are considered antecedents for absorptive capacity (Al-Shami et al, 2022). Leveraging on advances in digital technologies is supply chain visibility management is important (Sunmola, 2021).

6 Conclusions, limitations, and future research

Maintaining a competitive edge in supply chains is crucial for managers in today's dynamic and competitive business landscape. Supply chain visibility is an essential capability for achieving a desirable competitive advantage. This paper has set out to develop and evaluate a framework for analysing and understanding supply chain visibility. The primary objective was to understand the influence of supply chain linkages, supply chain relationship, and green absorptive capacity on information sharing and, consequently, their impact on the overall visibility of the supply chain.

The findings of this study revealed that green absorptive capacity significantly influenced information sharing and demonstrated a moderately high impact on supply chain visibility. These insights contribute to the emerging sustainable supply chain visibility field, offering valuable perspectives that can be globally applied. Notably, these results align with similar

research conducted in developed countries, highlighting the criticality of information sharing in supply chains for the survival and growth of firms, even in emerging economies.

Furthermore, this study examined the influence of external linkages and supply relationships on information sharing and supply chain visibility. The results indicated that external linkages had a relatively lower impact on supply chain visibility but demonstrated a moderate impact on information sharing. Similarly, supply chain relationships exhibited moderate impacts on both information sharing and visibility. These findings underscore the significance of fostering stakeholder integration practices that build trust within supply chains, leading to enhanced performance outcomes. These practices are equally relevant in emerging economies, emphasising the potential benefits of effective and efficient management of these variables. In conclusion, information sharing, strong supply chain relationships, robust internal linkages, and a high green absorptive capacity are key drivers of sustainable supply chain visibility, as evidenced by this study and its chosen constructs. In addition, these same factors, along with external linkages, also contribute to enhanced information sharing within the supply chain.

While this study provides valuable insights, it is important to acknowledge its limitations and suggest areas for future research. To gain a comprehensive understanding of the subject, future studies should explore additional theoretical aspects of the variables under investigation, going beyond the composite models used in this study. Moreover, considering the evolving nature of supply chain practices, researchers should incorporate a broader range of variables, including market trends, technological changes, and product/service characteristics that impact supply chain visibility. Additionally, collecting data over an extended period would enable researchers to examine the long-term effects of green absorptive capacity on visibility and performance. Furthermore, in discerning the distinct roles of internal and external linkages, this study opens doors for further exploration of how different linkage types (e.g., technological, informational)

can influence visibility. Lastly, future studies should incorporate more triple-bottom-line-oriented variables to align with the increasing necessity for their adoption and implementation.

References

Ab Hamid, M.R., Sami, W., Mohmad Sidek, M.H., 2017. Discriminant Validity Assessment: Use of Fornell & Larcker criterion versus HTMT Criterion, in: Journal of Physics: Conference Series. https://doi.org/10.1088/1742-6596/890/1/012163

Al-Shami, S., Bakri, M.H., Adil, H. and Mamun, A.A. (2022), "Information technology competencies as antecedents for absorptive capacity and innovation capabilities in a high-tech industry", Foresight, Vol. 24 No. 5, pp. 565-585. https://doi.org/10.1108/FS-12-2020-0129

Apeji, U.D., Sunmola, F.T., Khoudian, P., 2018. Cause-Effect Analysis for Distinctive Visibility in Sustainable Supply Chains: A Systematic Literature Review, in: Proceedings of the International Conference on Operations and Supply Chain Management,.

Baah, C., Acquah, I.S.K., Ofori, D., 2022a. Exploring the influence of supply chain collaboration on supply chain visibility, stakeholder trust, environmental and financial performances: a partial least square approach. Benchmarking 29, 172–193. https://doi.org/10.1108/BIJ-10-2020-0519

Baah, C., Opoku Agyeman, D., Acquah, I.S.K., Agyabeng-Mensah, Y., Afum, E., Issau, K., Ofori, D., Faibil, D., 2022b. Effect of information sharing in supply chains: understanding the roles of supply chain visibility, agility, collaboration on supply chain performance. Benchmarking: An International Journal 29, 434–455. https://doi.org/10.1108/BIJ-08-2020-0453

Barney, J.B., 2012. Purchasing, Supply Chain Management and Sustained Competitive Advantage: The Relevance of Resource-based Theory. Journal of Supply Chain Management 48, 3–6. https://doi.org/10.1111/j.1745-493X.2012.03265.x

Barratt, M., Barratt, R., 2011. Exploring internal and external supply chain linkages: Evidence from the field. Journal of Operations Management. https://doi.org/10.1016/j.jom.2010.11.006

Barratt, M., Oke, A., 2007. Antecedents of supply chain visibility in retail supply chains: A resource-based theory perspective. Journal of Operations Management 25, 1217–1233. https://doi.org/10.1016/j.jom.2007.01.003

Bartlett, P.A.A., Julien, D.M.M., Baines, T.S.S., 2007. Improving supply chain performance through improved visibility. The International Journal of Logistics Management 18, 294–313. https://doi.org/10.1108/09574090710816986

Blunch, N.J., 2017. Structural Equation Modeling with AMOS, in: Introduction to Structural Equation Modeling Using IBM SPSS Statistics and AMOS. pp. 76–108. https://doi.org/10.4135/9781526402257.n4

Burt, R.S., Soda, G., 2021. Network Capabilities: Brokerage as a Bridge Between Network Theory and the Resource-Based View of the Firm. J Manage 47, 1698–1719. https://doi.org/10.1177/0149206320988764

Cao, M., Zhang, Q., 2011. Supply chain collaboration: Impact on collaborative advantage and firm performance. Journal of Operations Management 29, 163–180.

Caridi, M., Moretto, A., Perego, A., Tumino, A., 2014. The benefits of supply chain visibility: A value assessment model. Int J Prod Econ 151, 1–19. https://doi.org/10.1016/j.ijpe.2013.12.025

Carter, J.R., Ellram, L.M., 1994. The Impact of Interorganizational Alliances in Improving Supplier Quality. International Journal of Physical Distribution & Logistics Management 24, 15–23. https://doi.org/10.1108/09600039410063991

Chen, J. V., Yen, D.C., Rajkumar, T.M., Tomochko, N.A., 2011. The antecedent factors on trust and commitment in supply chain relationships. Comput Stand Interfaces 33, 262–270. https://doi.org/10.1016/j.csi.2010.05.003

Chen, Y.S., Lin, Y.H., Lin, C.Y., Chang, C.W., 2015. Enhancing green absorptive capacity, green dynamic capacities and green service innovation to improve firm performance: An analysis of Structural Equation Modeling (SEM). Sustainability (Switzerland) 7, 15674–15692. https://doi.org/10.3390/su71115674

Conway, J.M., Lance, C.E., 2010. What reviewers should expect from authors regarding common method bias in organizational research. J Bus Psychol 25, 325–334. https://doi.org/10.1007/s10869-010-9181-6

Cronbach, L.J., Meehl, P.E., 1955. Construct validity in psychological tests. Psychol Bull 52, 281–302. https://doi.org/10.1037/h0040957

Dubey, R., Gunasekaran, A., Childe, S.J., Papadopoulos, T., Luo, Z., Roubaud, D., 2020. Upstream supply chain visibility and complexity effect on focal company's sustainable performance: Indian manufacturers' perspective. Ann Oper Res 290, 343–367. https://doi.org/10.1007/s10479-017-2544-x

Dutta, D., 2012. Inter-Organizational Relationships and Firm Performance: Impact of Complementary Knowledge and Relative Absorptive Capacity. Journal of Management Policy and Practice 13, 46–55.

Dyer, J.H., Singh, H., 1998. The relational view: Cooperative strategy and sources of interorganizational competitive advantage. Academy of Management Review 23, 660–679. https://doi.org/10.5465/AMR.1998.1255632

Fawcett, S.E.E., Osterhaus, P., Magnan, G.M.M., Brau, J.C.C., McCarter, M.W.W., 2007. Information sharing and supply chain performance: The role of connectivity and willingness. Supply Chain Management 12, 358–368. https://doi.org/10.1108/13598540710776935

Fulgence, B.E., Hu, X., Larbi-Siaw, O., Tuo, S.J., Gnahe, F.E., 2022. Impact of knowledge absorptive capacity on innovative performance in SMEs: mediating effect of cluster environment. Kybernetes. https://doi.org/10.1108/K-03-2022-0373

Ganbold, O., Matsui, Y., Rotaru, K., 2020. Effect of information technology-enabled supply chain integration on firm's operational performance. Journal of Enterprise Information Management. https://doi.org/10.1108/JEIM-10-2019-0332

Galbraith, J.R. (1973), Designing Complex Organizations, Addison-Wesley Pub. Co., Reading, MA

Golafshani, N., 2015. Understanding Reliability and Validity in Qualitative Research. The Qualitative Report. https://doi.org/10.46743/2160-3715/2003.1870

Goswami, S., Engel, T., Krcmar, H., 2013. A comparative analysis of information visibility in two supply chain management information systems. Journal of Enterprise Information Management 26, 276–294. https://doi.org/10.1108/17410391311325234

Grant, R.M., 1991. The Resource-Based Theory of Competitive Advantage: Implications for Strategy Formulation. Calif Manage Rev 33, 114–135. https://doi.org/10.2307/41166664

Gurzawska, A., 2019. Towards Responsible and Sustainable Supply Chains – Innovation, Multi-stakeholder Approach and Governance. Philos Manag. https://doi.org/10.1007/s40926-019-00114-z

Hair, J., Black, W., Babin, B., Anderson, R., 2010. Multivariate Data Analysis: A Global Perspective. Multivariate Data Analysis: A Global Perspective 7th.

Hair, J.F., Page, M., Brunsveld, N., 2019. Essentials of Business Research Methods, Essentials of Business Research Methods. https://doi.org/10.4324/9780429203374

Hart, S.L., Dowell, G., 2011. A natural-resource-based view of the firm: Fifteen years after. J Manage. https://doi.org/10.1177/0149206310390219

Henseler, J., Schuberth, F., 2020. Using confirmatory composite analysis to assess emergent variables in business research. J Bus Res 120, 147–156. https://doi.org/10.1016/j.jbusres.2020.07.026

Ibrahim, S.E., Ogunyemi, O., 2012. The effect of linkages and information sharing on supply chain and export performance: An empirical study of Egyptian textile manufacturers. Journal of Manufacturing Technology Management 23. https://doi.org/10.1108/17410381211230394

Jordan, P.J., Troth, A.C., 2020. Common method bias in applied settings: The dilemma of researching in organizations. Australian Journal of Management 45, 3–14. https://doi.org/10.1177/0312896219871976

Kaiser, H.F., 1974. An index of factorial simplicity. Psychometrika 39, 31–36. https://doi.org/10.1007/BF02291575

Kamble, S.S., Gunasekaran, A., Gawankar, S.A., 2020. Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications. Int J Prod Econ 219, 179–194. https://doi.org/10.1016/j.ijpe.2019.05.022

Kembro, J., Näslund, D., Olhager, J., 2017. Information sharing across multiple supply chain tiers: A Delphi study on antecedents. Int J Prod Econ 193, 77–86. https://doi.org/10.1016/j.ijpe.2017.06.032

Khan, M., Hussain, M., Saber, H.M., 2016. Information sharing in a sustainable supply chain. Int J Prod Econ 181, 208–214. https://doi.org/10.1016/j.ijpe.2016.04.010

Kimitei, E., Bonuke, R., Chepkwony, J., Kapkiyai, C., 2015. Moderating effect of information sharing on the relationship between supply chain linkages and supply chain performance. International Journal of Economics, Commerce and Management III, December 2015.

Klueber, R., O'Keefe, R.M., 2013. Defining and assessing requisite supply chain visibility in regulated industries. Journal of Enterprise Information Management 26, 295–315. https://doi.org/10.1108/17410391311325243

Knoppen, D., Johnston, D., Sáenz, M.J., 2015. Supply chain relationships as a context for learning leading to innovation. International Journal of Logistics Management 26, 543–567. https://doi.org/10.1108/IJLM-09-2012-0089

Lee, H., Kim, M.S., Kim, K.K., 2014. Interorganizational information systems visibility and supply chain performance. Int J Inf Manage 34, 285–295. https://doi.org/10.1016/j.ijinfomgt.2013.10.003

Li, T., Zhang, H., 2015. Information sharing in a supply chain with a make-to-stock manufacturer. Omega (United Kingdom) 50, 115–125. https://doi.org/10.1016/j.omega.2014.08.001

Lindner, J.R., Murphy, T.H., Briers, G.E., 2001. Handling Nonresponse In Social Science Research. J Agric Educ 42, 43–53. https://doi.org/10.5032/jae.2001.04043

Maghsoudi, A., Pazirandeh, A., 2016. Visibility, resource sharing and performance in supply chain relationships: insights from humanitarian practitioners. Supply Chain Management 21, 125–139. https://doi.org/10.1108/SCM-03-2015-0102

Marra, M., Ho, W., Lee, C.K.M., 2016. Managing supply chain knowledge-based linkages for improving operational performance. Knowledge Management Research and Practice 14. https://doi.org/10.1057/kmrp.2014.28

Mellinger, C.D., Hanson, T.A., 2021. Methodological considerations for survey research: Validity, reliability, and quantitative analysis. Linguistica Antverpiensia, New Series – Themes in Translation Studies 19, 172–190. https://doi.org/10.52034/lanstts.v19i0.549

Mentzer, J.T., Lambert, D.M., 2015. Estimating NonResponse Bias in Mail Surveys: A Replication Study, in: Marketing Horizons: A 1980's Perspective. pp. 222–224. https://doi.org/10.1007/978-3-319-10966-4_50

Nguyen, T.T.C., Tran, Q.B., Ho, D.A., Duong, D.A., Nguyen, T.B.T., 2021. The effect of supply chain linkages on the business performance: evidence from Vietnam. Uncertain Supply Chain Management 9. https://doi.org/10.5267/j.uscm.2021.6.009

Nguyen, T.T.H., Taskin, N., Scahill, S., Pauleen, D., 2019. Antecedents of supply chain information visibility: The complementarity effect of IT integration capability and interpersonal communication capability, in: 25th Americas Conference on Information Systems, AMCIS 2019.

Nulty, D.D., 2008. The adequacy of response rates to online and paper surveys: What can be done? Assess Eval High Educ. https://doi.org/10.1080/02602930701293231

Okongwu, U., Brulhart, F., Moncef, B., 2015. Causal linkages between supply chain management practices and performance: A balanced scorecard strategy map perspective. Journal of Manufacturing Technology Management 26, 678–702. https://doi.org/10.1108/JMTM-01-2013-0002

Ortas, E., Moneva, J.M., Álvarez, I., 2014. Sustainable supply chain and company performance: A global examination. Supply Chain Management 19, 332–350. https://doi.org/10.1108/SCM-12-2013-0444

Park, C.K., 2017. A Study on the Relationship between Supply Chain Visibility, Win-Win Cooperative Supply Chain, and Supply Chain Performance. Journal of the Korean Society of Supply Chain Management 17. https://doi.org/10.25052/kscm.2017.10.17.2.75

Podsakoff, P.M., MacKenzie, S.B., Lee, J.Y., Podsakoff, N.P., 2003. Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. Journal of Applied Psychology 88, 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Qu, X., Khan, A., Yahya, S., Zafar, A.U., Shahzad, M., 2022. Green core competencies to prompt green absorptive capacity and bolster green innovation: the moderating role of organization's green culture. Journal of Environmental Planning and Management 65, 536–561. https://doi.org/10.1080/09640568.2021.1891029

Ringle, C.M., Sarstedt, M., 2016. Gain more insight from your PLS-SEM results the importance-performance map analysis. Industrial Management and Data Systems. https://doi.org/10.1108/IMDS-10-2015-0449

Rogers, H., Fells, R., 2017. Successful buyer–supplier relationships: The role of negotiations. Journal of Strategic Contracting and Negotiation 3, 121–136.

Rungtusanatham, M., Salvador, F., Forza, C., Choi, T.Y., 2003. Supply-chain linkages and operational performance: A resource-based-view perspective. International Journal of Operations and Production Management 23, 1084–1099. https://doi.org/10.1108/01443570310491783

Sadeghi R., K., Azadegan, A., Ojha, D., 2023. A path to build supply chain cyber-resilience through absorptive capacity and visibility: Two empirical studies. Industrial Marketing Management 111, 202–215. https://doi.org/10.1016/J.INDMARMAN.2023.04.001

Saqib, Z.A., Zhang, Q., 2021. Impact of sustainable practices on sustainable performance: the moderating role of supply chain visibility. Journal of Manufacturing Technology Management. https://doi.org/10.1108/JMTM-10-2020-0403

Shibin, K.T., Dubey, R., Gunasekaran, A., Hazen, B., Roubaud, D., Gupta, S., Foropon, C., 2020. Examining sustainable supply chain management of SMEs using resource based view and institutional theory. Ann Oper Res 290, 301–326. https://doi.org/10.1007/s10479-017-2706-x

Song, M., Yang, M.X., Zeng, K.J., Feng, W., 2020. Green Knowledge Sharing, Stakeholder Pressure, Absorptive Capacity, and Green Innovation: Evidence from Chinese Manufacturing Firms. Bus Strategy Environ 29, 1517–1531. https://doi.org/10.1002/bse.2450

Sunmola, F.T., 2021. Context-Aware Blockchain-Based Sustainable Supply Chain Visibility Management, in: Procedia Computer Science. pp. 887–892. https://doi.org/10.1016/j.procs.2021.01.339.

Sunmola, F., Burgess, P., Tan, A., Chanchaichujit, J., Balasubramania, S., Mahmud, M., (2023) Prioritising Visibility Influencing Factors in Supply Chains for Resilience, Procedia Computer Science, Volume 217, Pages 1589-1598, ISSN 1877-0509, https://doi.org/10.1016/j.procs.2022.12.359.

Taber, K.S., 2018. The Use of Cronbach's Alpha When Developing and Reporting Research Instruments in Science Education. Res Sci Educ 48, 1273–1296. https://doi.org/10.1007/s11165-016-9602-2

Wang, L., Pfohl, H.-C., Berbner, U., Keck, A.K., 2016. Supply Chain Collaboration or Conflict? Information Sharing and Supply Chain Performance in the Automotive Industry. pp. 303–318. https://doi.org/10.1007/978-3-319-21266-1_20

Weide, A.C., Beauducel, A., 2019. Varimax rotation based on gradient projection is a feasible alternative to SPSS. Front Psychol 10. https://doi.org/10.3389/fpsyg.2019.00645

Wernerfelt, B., 1995. The resource-based view of the firm: Ten years after. Strategic Management Journal 16, 171–174. https://doi.org/10.1002/smj.4250160303

Williams, B.D., Roh, J., Tokar, T., Swink, M., 2013. Leveraging supply chain visibility for responsiveness: The moderating role of internal integration. Journal of Operations Management 31, 543–554. https://doi.org/10.1016/j.jom.2013.09.003

Zelbst, P.J., Green, K.W., Sower, V.E., Reyes, P., 2009. Impact of supply chain linkages on supply chain performance. Industrial Management and Data Systems 109, 665–682. https://doi.org/10.1108/02635570910957641