



(RESEARCH ARTICLE)



The influence of business intelligence on the effectiveness of supply chain management in the Nigerian consumer goods sector

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International Journal of Science and Research Archive, 2024, 13(01), 1884–1896

Publication history: Received on 22 August 2024; revised on 01 October 2024; accepted on 03 October 2024

Article DOI: <https://doi.org/10.30574/ijrsra.2024.13.1.1855>

Abstract

Business performance depends on supply chain management (SCM), which can be enhanced through digital transformation to enable quick decisions to increase market share. By enabling informed decision-making, business intelligence (BI) can facilitate this improvement in SCM effectiveness and competitive edge. Real-time production and inventory level monitoring is made possible by BI capabilities, which help organisations adapt to changing market trends and meet customer demands. Particularly, BI technology can increase the SCM of enterprises in the consumer products sector by providing value-added and financial gains, enabling speedy industry adoption and rapid industry growth. The study employed a quantitative methodology for gathering data, and a simple random sampling method was employed to prevent sample bias. The study considered linear curve estimation (LCE) as a method of data analysis. The results of the model estimations showed that BI recorded positive and significant influence on SC visibility, flexibility, and resilience in the Nigerian consumer goods sector. The study concludes that BI increased the effectiveness of supply chain management (SCM) by improving visibility, anticipating demand, increasing resilience, optimising processes, and boosting productivity. SCM effectiveness depends on the efficient handling of disruptions and uncertainty. The study highlights the practical policy implications following the findings of the study.

Keywords: Supply chain management; Business intelligence; Inventory management; Decision-making; Linear curve regression

1. Introduction

The Nigerian consumer goods sector is expanding and offers chances for a wide range of commodities. The consumer goods sector in Nigeria consists of food and beverages, apparel, real estate, cars, and personal care and household products. With over three million employees, the consumer goods sector is the fourth-largest sector in Nigeria and contributes significantly to GDP. The top 5 consumer goods companies in Nigeria brought in N504.72 billion in sales in the first half of 2022, surpassing their 2021 revenue of N126.08 billion (Duplo, 2023). Dangote Sugar Plc, Nascon Plc, Unilever Plc, Nestle Plc, and Cadbury Nigeria Plc are the top 5 companies in the Nigerian consumer goods sector. A comparison of their half-year financial statements shows that during the first half of 2022 and 2021, these companies' revenue increased by 33.3%. The Nigerian consumer goods sector is one of the most prosperous sectors in the country, with a considerable number of companies producing a broad variety of goods (Duplo, 2023). Several studies indicate that the performance and profitability of the Nigerian consumer goods sector can be influenced by a number of variables, including business intelligence (BI), sophisticated technology, branding, capital structure, market share position, and corporate qualities (Abioro & Odunlami, 2021; Alao & Sanyaolu, 2020; Usman, 2019). As a result, companies in the sector concentrate on various strategies to raise their visibility and increase their performance and profitability.

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One of the key factors influencing corporate success is an organisation's ability to effectively manage its supply chains (SCs), and supply chain management (SCM) is not exempt from the digital revolution that is being used in all sectors of the economy to boost productivity (Tozin & Amaro, 2022). One digital revolution that can significantly improve SCM is BI (Al-Radaideh et al., 2023). A key component of SCM is BI, which enables organisations to evaluate requirements, store critical data in an easily accessible format, and make operational and planning decisions. Thus, as BI gives companies a competitive edge, enhances performance, and facilitates better decision-making, it is a crucial component of SCM. BI is a subfield of artificial intelligence (AI) that focusses on optimising business processes with minimal or no human intervention (Sujith et al., 2022). BI facilitates the collection of data from several sources, such as internal systems, suppliers, and customers. This data can be used to identify patterns, trends, and insights that help improve SC performance. By frequently evaluating its performance and making the necessary corrections, the SC may be managed at the highest degree of effectiveness.

BI can increase the visibility, flexibility, and resilience of the SC by providing real-time and historical data analysis, revealing trends, patterns, and insights that can be utilised to make informed decisions (Agarwal, 2018; Modgil et al., 2021; Singagerda et al., 2022). The advent of BI technologies has given companies an unparalleled opportunity to enhance their decision-making abilities and gain a competitive edge (Al-Radaideh et al., 2023). Modgil et al. (2021) affirm that BI can contribute to increased SC flexibility and resilience by strengthening skills related to visibility, risk, sourcing, and distribution. Singagerda et al. (2022) assert that the visibility, flexibility, and resilience of SCs can positively and significantly impact business performance. BI can help with demand forecasting in the SC by employing real-time monitoring, ANNs, predictive analytics, data analysis, and visualisation. Businesses may gain a competitive edge, make informed decisions, and enhance the performance of their SCs by utilising these technologies (Ampazis, 2011; Kochak & Sharma, 2015; Upadhyaya & Kakkad, 2020).

In light of this, SC activities can be tracked in real-time with the use of BI tools, allowing companies to quickly identify and adjust to shifts in customer demand. Production and inventory levels can be adjusted to meet changing demand by utilising real-time monitoring (Rozga, 2013). Tozin and Amaro (2022) affirm that companies that integrate their BI and SCM systems have a major competitive edge. Al-Radaideh et al. (2023) discovered that BI had a significant effect on SCM and business performance in small- and medium-sized enterprises (SMEs). SC integration acts as a mediating factor in the relationship between BI and business performance. BI and SCM, in particular, are significant fields in the consumer goods sector. Utilising BI to fully and accurately manage their SCs, consumer goods companies may reap the benefits of the diversity of information at their disposal. Adoption of BI technology can occur quickly across the board in the sector and has the potential to yield substantial value-added for the sector in addition to financial gain (Sazu & Jahan, 2022).

According to findings from existing studies, BI can assist consumer goods companies in forecasting demand (Khan et al., 2020; Pencheva, 2020; Zeng et al., 2022; Krishna, 2022). Njuguna and Ndolo (2021) discovered that the SC performance of Kenyan consumer goods companies was highly impacted by warehouse and inventory management systems (BI systems). To the best of the study's knowledge, no research has been done on BI and SCM in Nigeria, which leaves a research gap. It is therefore of primary research interest to comprehend this perspective in the context of the Nigerian consumer goods sector (NCGS). On that note, bridging this gap will lead to answering various relevant questions. To what extent does BI influence SC visibility in NCGS? To what extent does BI influence SC flexibility in NCGS? To what extent does BI influence SC resilience in NCGS? The study adopted linear curve estimation (LCE), and this method helped in determining if the influence of BI on the effectiveness of SCM was sufficiently linear.

2. Literature Review

BI is the main component of decision support systems and processes that facilitate effective decision-making and the creation of visible, flexible, and resilient supply chains (SCs) (Saraghi, 2016). Businesses are beginning to realise that supply chain management (SCM) is crucial to establishing a sustainable competitive edge for their products or services in a market that is becoming more competitive (Jamehshooran et al., 2015). Strong applications and systems are essential for real-time tracking, logistics, operations, sales, production, and financial data for performance management (Jalil et al., 2019). Businesses that use analytics decision-making outputs in SCs to increase profitability (Hazen et al., 2016). Procedures for SC operation planning are outlined in the plan processes. Through data collection, resource balancing, and customer requirements gathering, supply planning finds gaps in capabilities and resources (Jamehshooran et al., 2015). The majority of the prevalent SCM theories encourage a worldwide hunt for inexpensive labour and resources by adopting a reductionist and static perspective on the field. SCs that are visible, flexible, and resilient are capable of responding to changes in demand patterns substantially more quickly (Wieland, 2021).

BI tracks inventory levels and delivery schedules, improves SC visibility, and analyses company operations using data analysis tools (Rozga, 2013; Šerić et al., 2014; Pundir et al., 2019; Tan et al., 2023). Trkman et al. (2010) demonstrated

a statistically significant relationship between performance and analytical abilities. Ghadge et al. (2020) assert that there has been a notable advancement in the attempts to digitise, automate, and enhance the flexibility of SCs. This has made it possible to build reliable, transparent, flexible, and efficient systems in SC phases by utilising a variety of technologies. Employing BI to boost SC flexibility is becoming more important (Moniruzzaman et al., 2015). In terms of both agile capabilities and agile performance, Sangari and Razmi (2015) clearly affirm that SC-BI competence is a crucial enabler of SC flexibility. The authors support the idea that SC-BI competence is a multidimensional construct that includes managerial, technical, and cultural competence. The results provide more evidence in favour of the theory that BI proficiency and SC flexibility are mediated in part by agile capabilities. BI has to be a part of an effective SCM strategy. When it comes to SCM, BI is concerned with the kind and volume of information sharing (Banerjee & Mishra, 2017).

The relationship between BI and SC visibility is complicated and multifaceted due to the many factors that influence it. Nevertheless, studies suggest that using BI tools and methodologies can help companies increase their SC understanding and improve their operational decision-making (see, for instance, Rozga, 2013; Šerić et al., 2014). Šerić et al. (2014) investigated the relationship between SCM and BI for marketing decisions. The authors found that the two are related and that integrating BI with SCM can make a business stand out from the crowd. Similarly, Rozga (2013) looked into the relationship between BI and SCM. The study found a significant relationship between information visibility, SC partners' integration, BI, and SCM. Jafari et al. (2023) establish the importance of BI, integration, and flexibility in enhancing SC performance. BI has the biggest influence on the SC's performance. Furthermore, BI positively and significantly affects the flexibility and integration of SC. The study also found that the inclusion of BI technologies has a direct impact on SC flexibility. Wang et al. (2016) observed that SC flexibility is employed for insourcing, SC network design, and product design and development at the strategic level.

The ability of SC flexibility to assist managers and decision-makers in understanding changing market conditions, identifying and assessing SC risks, and utilising SC skills to create innovative, workable SC plans can all contribute to increasing SC flexibility and profitability. Al-Khatib (2023) observed a positive and significant correlation between the BI and the visibility of the SC and operational performance. Digital twins can help create predictive metrics, diagnostics, predictions, and physical asset descriptions in addition to increasing the visibility of a business's logistics supply network (Moshood et al., 2021). All management decisions in the field of SC logistics are based on insightful information, which also promotes the organisation's sustainable growth and aids in the accomplishment of its goals (Evtodieva et al., 2020). Kaur (2021) found that responsiveness to the SC has a significant positive impact on agile performance, BI competence has a significant positive impact on SC agility performance, and agility has a significant positive impact on responsiveness to the SC.

On the other hand, Hunaid et al. (2022) assert that SC visibility is the capacity to trace and keep an eye on products as they pass through the SC, from raw materials to completed goods. The development of predictive metrics, diagnostics, predictions, and physical asset descriptions for logistics can be facilitated by SC visibility (Kalaiarasan et al., 2022). Accurate demand forecasting, SC effectiveness, and preventing shortages all depend on SC visibility (Hunaid et al., 2022; Singagerda et al., 2022; Kalaiarasan et al., 2022). Singagerda et al. (2022) reveal that SC visibility has a positive and significant impact on a company's success. Companies may improve SC performance, forecast consumer demand more precisely, and ensure they never run out of supplies at peak or off-peak periods (Boile & Sdoukopoulos, 2014; Hunaid et al., 2022).

Introducing SC visibility can help companies operate more efficiently and make better decisions by providing them with access to real-time data, boosting teamwork, boosting decision-making, better tracking business risks, and building predictive skills (Goswami et al., 2013). Jayashree and Priya (2019) affirm that companies can improve their order management by using SC visibility data to monitor sales order progress at various stages of the order lifecycle. For businesses, the development of operational, tactical, and strategic advantages are all potential outcomes of SC awareness (Boile & Sdoukopoulos, 2014). Businesses can enhance their logistics by utilising SC visibility to offer physical asset descriptions, diagnostics, projections, and predictive analytics. This will enable them to decide on their SC activities with greater knowledge (Kokkotas, 2014).

While there is a risk of data breaches because the visibility of the SC requires the sharing of private information among many parties (Boile & Sdoukopoulos, 2014), Freichel et al. (2022) claim that implementing SC visibility can be challenging, particularly in distribution logistics where there are many stakeholders. SC visibility depends on mutual trust, and a loss of trust can lead to poor performance and hindered communication. Boile and Sdoukopoulos (2014) posit that enhanced SC visibility can boost SC security, and SC security is a top priority for businesses and governmental organisations. Implementing SC visibility may need a significant investment in infrastructure and technology, which may increase costs for companies (Müller & Gräf, 2014). Freichel et al. (2022) emphasise that since inaccurate data can lead to poor judgements and performance, data quality is essential for SC visibility.

- H1: Business intelligence has positive influence on supply chain visibility.

SC flexibility unifies activities from suppliers to consumers, lowers unpredictability, improves organisational effectiveness, and evaluates performance (Wang et al., 2016). Flexible alternatives are incorporated into SC design through the structural flexibility approach (Christopher and Holweg, 2011). The requirement for SC flexibility is driven by the corporate environment's rising rate of change and volatility (Ismail & Sharifi, 2006). Wang et al. (2016) assert that SC flexibility may help achieve a number of crucial objectives to guarantee that sourcing strategies are in accordance with the strategic aims and objectives of a business. By looking at market trends and economics, SC Flexibility examines spending, procurement, future demand, and sourcing strategies. The key components of a flexible supply chain are speed and elasticity. To make decisions quickly and adjust to changes, a flexible SC needs to have simultaneous access to the data of all of its chain partners, customers, and goods (Pool et al., 2018). Lower operating costs and increased customer satisfaction are just two possible advantages of SC flexibility (Anatan, 2006). A company's flexibility is determined by how quickly it can adapt to shifts in demand, both in terms of volume and diversity, and SC flexibility is responsive to the market (Christopher, 2000; Anatan, 2006). According to Tukamuhabwa et al. (2015), SCs that exhibit greater flexibility may be able to respond to disruptions faster and carry. Christopher (2000) and Anatan (2006) claim that flexibility increases responsiveness by allowing producers to virtually work together to take advantage of appealing opportunities.

Organisational structures, information systems, and logistics procedures must all be flexible across the board for a SC to be considered flexible (Christopher & Towill, 2001). Promoting the fundamental notion that flexibility is the capacity to foresee changes and seize new possibilities as they present themselves (Ismail and Sharifi, 2006). A flexible organisation also must balance other essential elements such as SC alliances, market adaptability, and long-term competitive strategy (Anatan, 2006; Ismail and Sharifi, 2006). The corporate environment's increasing rate of change and volatility is what drives the need for SC flexibility (Ismail and Sharifi, 2006). Geyi et al. (2019) establish that organisations' responses to the market's need for sustainable products lead to the development of flexible capabilities. SC flexibility is the ability to respond quickly to changes in the market, supply, and demand. Flexible SCs are able to react to disruptions and carry on with operations (Tukamuhabwa et al., 2015).

- H2: Business intelligence has positive effect on supply chain flexibility.

Backup suppliers, inventory, and transportation options are necessary for the SC to continue operating in the event that one of its components fails (Tukamuhabwa et al., 2015). SC resilience is necessary because of the severity and frequency of SC disruptions, which are exacerbated by the high degree of uncertainty and unpredictability (Shahrami et al., 2022). Collaboration requires establishing trustworthy relationships with suppliers, clients, and other SC stakeholders (Tukamuhabwa et al., 2015). Sharing risks, resources, and knowledge through cooperative interactions can help SCs become more resilient. The fundamental stages of SC resilience, include anticipation (active planning and thought), resistance (preserving structure and function), response (quick and effective reactions), and recovery (Bahrami et al., 2022). Because of this, businesses need to be ready for disruption so they can react quickly and creatively when it occurs (Bahrami & Shokouhyar, 2021). Kopanaki (2022) asserts that resilient SCs are equipped to deal with unforeseen circumstances, respond quickly, and resume operations following an interruption. Crisis preparedness is guaranteed by the flexible SC's capacity to boost resilience in general (Sengupta et al., 2022).

Building SC resilience entails assessing risks, locating weak links in the chain, and determining inventory levels by talking to suppliers and consumers (Tukamuhabwa et al., 2015). Kopanaki (2022) highlights that resilience management in the SC includes handling supply fluctuations as well as variations in production volume and capacity, quick modifications to product design, and a range of promotional initiatives. Similarly, a proactive or reactive approach is needed for a SC to be able to resume regular operations following an interruption. SCs must develop their ability to adapt in order to be prepared for both unanticipated and dangerous circumstances (Ozdemir et al., 2022; Bahrami et al., 2022). If businesses wish to manage SC vulnerability and its impacts, they need to invest in resilience.

Long-term strategic investment is necessary to attain SC resilience, which is enhanced by the complementary and useful abilities of visibility and analysis. Disruptions are necessary for a SC to function at its best and stay robust (Bahrami et al., 2022). Businesses can assess the resilience of their SC by identifying the critical elements that need to be protected and assessing how disruptions affect their SC (Tukamuhabwa et al., 2015). However, decentralisation will reorganise the SC to reduce dependency on a certain supplier or area. This can maintain supply systems running and mitigate the impact of disruptions. Long-term SC resilience improvement requires a blend of proactive and reactive tactics. Supply networks must become adaptive in order to be prepared for unforeseen and hazardous events (Tukamuhabwa et al., 2015; Ozdemir et al., 2022).

- H3: Business intelligence has positive influence on supply chain resilience.

3. Data and Method of Analysis

The purpose of the study is to examine the influence of BI on the effectiveness of SCM in the Nigerian consumer goods sector. In order to enable the researcher to collect meaningful and reliable data, this study carefully analyses the research objectives to select appropriate methods of analysis. Using the explanatory survey research method, this study collected significant data that was used for analysis of the data. This method aids in identifying links, patterns, or trends in SCM and BI; this approach is deemed appropriate. Using prior research on SCM and BI as a guide, the study created a questionnaire for data collection used in statistical data analysis. After a comprehensive examination of multiple themes related to SCM and BI measurements, the investigator created the survey questions.

The study used an online approach; copies of the questionnaire were distributed to employees in the logistics and supply chains units of Dangote Sugar Plc, Nascon Plc, Unilever Plc, Nestle Plc, and Cadbury Nigeria Plc via an online Google form. Employees were given a link to the online survey form, which was completed with the assistance of the HR managers of the companies. Consent notice, demographics, and closed-ended questions concerning SCM and BI make up the three components of the online survey questionnaire. A five-point Likert scale was used to produce a 20-item questionnaire. The numbers on the scale ranged from 1 for "strongly disagree" to 5 for "strongly agree," for the employees to logically express their position with respect to the various questions. The title of the study was disclosed to the participants. Following the collection of a sufficient number of responses, the data was assessed to guarantee its applicability.

It seemed improbable that the researcher would survey all employees at the case companies in order to collate the required data. We used samples from the population and generalised from them to find a result. A sample is a subset of the universe or population that faithfully captures the essential characteristics, perspectives, dispositions, or behaviours of the complete population. On this note, a simple random sampling technique was used to select a sample of individuals from the entire population and avoid bias in the sample. Every member has an equal chance of being selected for the sample using this method, which has no bearing on the selection of other members (Chun et al., 2003). The sample size of 186 was ascertained using the Yaro Yamane sample size (n) method, which was based on the population size of 347 employees in the logistics and supply chain unit of the case companies.

Explanatory surveys often use statistical analysis to assess and present the collected data. This study used linear curve estimation (LCE) to evaluate the impact on the hypothesised presumptions. This method helped determine whether the impact for the various models was sufficiently linear. It fits a linear equation to the observed data in order to determine the relationship between two variables (Chen & Pearl, 2014; Nestler, 2022). LCE is a useful technique for assessing linear relationships between variables in a complex model. Regression, factor analysis, and latent growth curve modelling are some of the techniques that would be used to solve linear equation systems simultaneously in this situation (Alhija, 2010). The model framework for the hypotheses of this study is shown in figure 1 below.

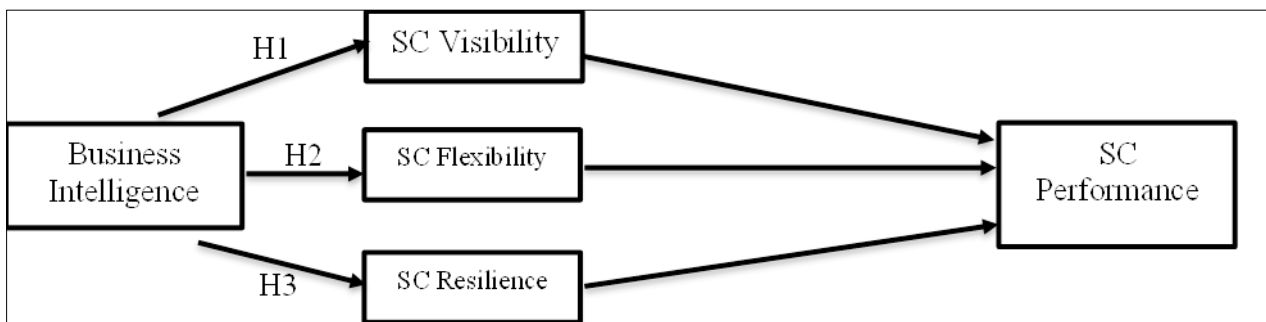


Figure 1 Model Framework

This statistical approach assisted the study in obtaining significant and reliable results, which are consistent with the work of Trkman et al. (2010), Jafari et al. (2023), Pool et al. (2018), Sangari and Razmi (2015), Seddigh et al. (2023), and Adaileh et al. (2022), among others. Business intelligence (BI), supply chain visibility (SCV), supply chain flexibility (SCF), and supply chain resilience (SCR) are the variables used in the estimation. The linear curve estimation models are formulated below.

$$SCV_i = \beta_0 + \beta_1 BI_1 + \mu_i \dots\dots\dots (1)$$

$$SCF_i = \beta_0 + \beta_1 BI_1 + \mu_i \dots\dots\dots (2)$$

$$SCR_i = \beta_0 + \beta_1 BI_1 + \mu_i \dots\dots\dots (3)$$

Where:

- SCV_i = Dependent Variable Measured by Supply Chain Visibility
- SCF_i = Dependent Variable Measured by Supply Chain Flexibility
- SCR_i = Dependent Variable Measured by Supply Chain Resilience
- BI₁ = Independent Variable Measured by Business Intelligence
- β₀ = Intercept of the Estimation Model
- β₁ = Coefficient of Determination Associated with Independent Variable
- μ = Random Error Associated with the Estimation Model.

Cronbach's alpha was used for the reliability test. Cronbach's alpha is an essential parameter for evaluating the accuracy and consistency of measuring scales used in research (Kilic, 2016). A low alpha value may indicate that there are not many questions on the scale, and an appropriate Cronbach's alpha coefficient value is 0.7 or higher (Peterson, 1994; Kilic, 2016). Validity testing is just as important to research methods as reliability testing. It explains the extent to which a measurement or test is able to capture the intended data. Whether the research is measuring what it is supposed to measure is what validity is all about (Ozener et al., 2021; Sürücü & Maslakci, 2020). Ethical considerations ensured that study participants were provided with a consent note that included their informed consent as well as their free acceptance to engage in the study. The confidentiality and privacy of the survey’s data were guaranteed.

4. Results and Discussion

4.1. Correlation Matrix

Correlation analysis was used to determine the association between the variables employed in the study. There is a clear and positive correlation between these variables, as shown by the data in Table 1. This is an indication that the hypothesised relationships were first validated by the study outcomes considerable positive correlation.

Table 1 Pearson Product-Moment Correlation Coefficient

Variables	BI	SCV	SCF	SCR
BI	1			
SCV	0.735**	1		
SCF	0.677**	0.898**	1	
SCR	0.673**	0.894**	0.919**	1

Source: Correlation Coefficient Results using SPSS; Note: (1) Number of observation is 153. This is total number of employees that participated in the survey out of 186 sample size.; (2) **. Correlation is significant at the 0.01 level (2-tailed).; (3) BI = Business Intelligence, SCV = Supply Chain Visibility, SCF = Supply Chain Flexibility, SCR = Supply Chain Resilience.

4.2. Supply Chain Visibility and Business Intelligence

The results in Table 2 depict an intercept estimate with a coefficient value of 1.184, and statistical significance at the 5% level suggests that SC visibility increased by 1.18% while the model parameter remained constant. The regression analysis showed a coefficient of 0.709, or the slope estimate, when examining the impact of BI on SC visibility of the Nigerian consumer goods sector. This result was positive and statistically significant at the 5% level of significance. This suggests that a 0.71% increase in SC visibility was caused by a 1% increase in BI capabilities. The value of 0.053 is the standard error, which estimates the standard deviations of the corresponding sampling distributions.

Table 2 Supply Chain Visibility and Business Intelligence

SCV	Coefficients	Std. Error	R	R Square	Adjusted R Square
Constant	1.184*	0.232	0.735	0.541	0.538
BI	0.709*	0.053			

Source: Curve Linear Estimation using SPSS; Note: (1) Number of observation is 153. This is total number of employees that participated in the survey out of 186 sample size.; (2) SCV = Supply Chain Visibility, BI = Business Intelligence; *Significant at 5%.

In this instance, the BI standard error of 0.053 provides insight into the range of variability of the estimate for the coefficient of BI, which is 0.709 but will fluctuate with a standard deviation of roughly 0.053 around the true, unknown value if the study replicates the entire experiment multiple times. The model summary showed the goodness of fit with the R square value of 0.541. R-squared, also known as the coefficient of determination, measures the percentage of variance in the dependent variable that the regression model accounted for. The result of 0.541 shows that 54.1% variation of SC visibility was described by the estimation model. The adjusted value of our R-Square showed that this variance dropped to 53.8%, which is a sign the study model is a good fit.

4.3. Supply Chain Flexibility and Business Intelligence

The influence of BI on the SC flexibility of the Nigerian consumer goods sector was evaluated using regression analysis. The findings in Table 3 demonstrated that the intercept estimate had a coefficient value of 1.458 when the model parameter was fixed, and this was statistically significant at the 5% level. This implied that SC flexibility had improved by 1.46%. With a coefficient of 0.643, the BI slope estimate was positive and statistically significant at the 5% level of significance. This demonstrates that a 1% increase in BI capabilities led to a 0.64% increase in SC flexibility. The estimated standard deviations of the pertinent sample distributions, or standard errors, have a value of 0.057.

Table 3 Supply Chain Flexibility and Business Intelligence

SCF	Coefficients	Std. Error	R	R Square	Adjusted R Square
Constant	1.458*	0.248	0.677	0.459	0.455
BI	0.643*	0.057			

Source: Curve Linear Estimation using SPSS; Note: (1) Number of observation is 153. This is total number of employees that participated in the survey out of 186 sample size.; (2) SCF = Supply Chain Flexibility, BI = Business Intelligence; *Significant at 5%.

A sense of the extent of the variability is provided by the standard error of 0.057 for BI, which is 0.643 in this case but will vary with a standard deviation of 0.057 around the true, unknown value if the study repeats the entire experiment multiple times. The model description indicates that the R square, which gauges how well the model fits the data, is 0.459. This outcome for the coefficient of determination means that the model explained 45.9% of the variation in SC flexibility. The variability dropped to 45.5% when the R-Square adjusted was determined, suggesting that the regression model fit the data well.

4.4. Supply Chain Resilience and Business Intelligence

Table 4 Supply Chain Resilience and Business Intelligence

SCR	Coefficients	Std. Error	R	R Square	Adjusted R Square
Constant	1.363*	0.256	0.673	0.453	0.450
BI	0.656*	0.059			

Source: Curve Linear Estimation using SPSS; Note: (1) Number of observation is 153. This is total number of employees that participated in the survey out of 186 sample size.; (2) SCR = Supply Chain Resilience, BI = Business Intelligence; *Significant at 5%.

Regression analysis was used to assess the effect of BI on SC resilience in the Nigerian consumer goods sector. Table 4 shows that when the model parameter was fixed, the coefficient value of the intercept was 1.363, and this was statistically significant at the 5% level. This is an indication that SC resilience increased by 1.36% when there was no change in BI. The coefficient value for the BI slope estimate was 0.656 and statistically significant at the 5% level of significance. This indicates that SC resilience increased by 0.66% for every 1% increase in BI capability. The standard errors with a value of 0.059 are the estimated standard deviations of the relevant sample distributions.

The range of variability for the estimate of the BI coefficient, which in this case is 0.656, is indicated by the standard error of 0.059 for BI. If the study repeats the entire experiment multiple times, the estimate will vary with a standard deviation of 0.059 around the true, unknown value. The model description indicates that the R square, a measure of how well the model fits the data, is 0.453. This is an indication that the model was able to explain 45.3% of the variation in SC resilience. The adjusted R-Square showed that this variation dropped to 0.450, suggesting that the regression model fit the data well.

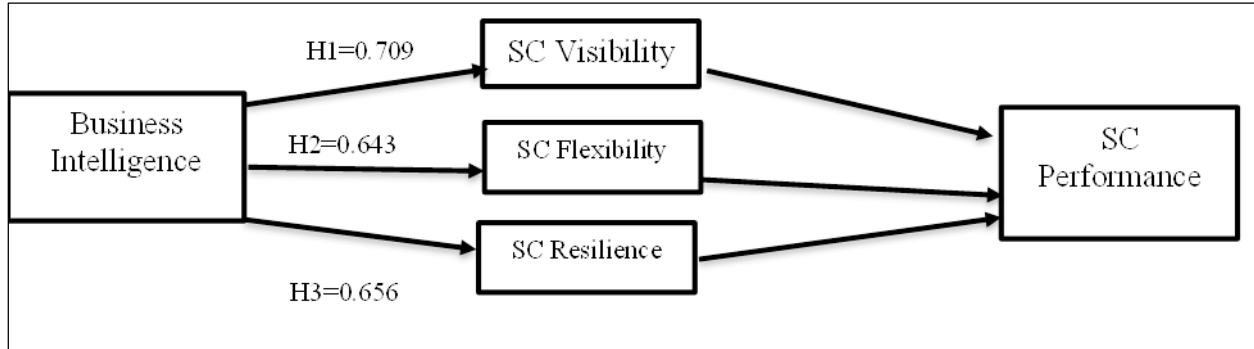


Figure 2 Results of the Model Estimations

4.5. Reliability and Validity

The study utilised Cronbach's alpha to compare responses for various scale items in order to assess whether or not they are consistent with one another. The Cronbach's alpha coefficient results for the scale were greater than 0.7, indicating strong reliability for all of the elements. This indicates that the study met the internal consistency and reliability requirements for the survey. The further outcomes show that the results are substantial enough to exhibit convergent validity, as the factor loading indicated. The pattern matrix results likewise averaged higher than 0.7. The study produced excellent results for the validation of the discriminant validity since there was no cross-loading among the factors, and the factor correlation matrix result indicated that the correlation between the factors was greater than 0.7. The sample adequacy measure was demonstrated by the KMO and Bartlett's test, which yielded good findings and was statistically significant at the 5% level with a coefficient of 0.951, which is above 0.7. The test's goodness of fit, which has a 343.955 Chi-Square value and is statistically significant at the 5% level, indicates an excellent fit.

5. Conclusions

The study concludes that supply chain management effectiveness in the Nigerian consumer goods sector is significantly influenced by business intelligence. Operational efficiency and successful SCM depend on BI. Making better operational decisions and improving SC knowledge can be achieved through the use of BI tools and processes. SC performance can be enhanced by BI integration and flexibility, with BI having the greatest influence on SC integration and flexibility. SC visibility may help firms make better decisions, work together more effectively, and monitor business risks by giving them access to real-time information and fostering predictive capabilities. It helps businesses anticipate demand, make sure they never run out of anything at busy or slow periods, and increase the effectiveness of their SCs. BI helps SCs react quickly and nimbly to market developments, which enhances customer satisfaction by identifying needs and producing customised goods. SCM integrates activities and stakeholders to optimise the SC, reduce costs, increase productivity, and improve customer satisfaction. SCM entails coordinating activities such as procurement, transportation, distribution, and manufacturing to guarantee a steady flow of goods and services while boosting productivity, lowering expenses, and raising customer satisfaction.

A flexible SC is necessary for a business to be competitive in the marketplace. This necessitates striking a balance between SC alliances, market adaptability, and long-term competitive strategy. Prioritising speed and adaptability, a flexible SC necessitates data access from all partners and clients. Online BI data helps make judgements about the SC online and enables quick adjustments in response to system changes. Flexibility in organisational structures, information systems, logistics procedures, and mentalities are all necessary for a flexible SC. BI systems give managers at different organisational levels quick, accurate, and user-friendly information to assess SC disruptions. BI is built on reliable, relevant information, giving organisations access to critical data and enhancing operations. To strengthen SC resistance to market volatility, companies have implemented different initiatives. Adopting BI enables organisations to use analytical capabilities to reduce risks and be ready to deal with unforeseen circumstances, respond swiftly, and resume operations following disruption. Supply networks must develop the ability to adjust to both dangerous and

unanticipated circumstances. BI helps lessen the impact of SC disruptions. Businesses can test the resilience of their SC and ascertain the optimal inventory levels needed to sustain operations during disruptions by analysing the effects of disruptions on their SC and identifying critical elements. Customer loyalty and satisfaction depend on the ability of SC to handle risks and disruptions.

5.1. Policy Implications

The study discovered that business intelligence made a substantial contribution to supply chain visibility in the Nigerian consumer goods sector. Stakeholders must guarantee efficient communication and information exchange among SC participants in order to improve visible SCs. Successful SCs require effective communication between participants in order to facilitate improved coordination, collaboration, and decision-making. Improve communication in the organisation by holding frequent meetings, providing clear channels of communication, and using the right techniques. To avoid delays and shortages, improve communication with external stakeholders like distributors, suppliers, and transportation companies. Select appropriate channels of communication, encourage openness, build trusting relationships with suppliers, and make technological investments to support information exchange and cooperation between SC participants. Businesses can improve their SC analytics, responsiveness, and overall performance by concentrating on information technology, external collaboration, and internal cooperation.

Informed strategic decisions for efficient SCM are made possible by BI tools, which analyse data for reporting, analytics, and trend identification. In order to improve transparency, data protection, reliability, consensus processes for dynamic data storage, and security of information management systems and SC frameworks, SC stakeholders must integrate and apply BI software solutions effectively. Because improper handling of sensitive data can be dangerous, data security is essential to BI systems. Techniques for data masking maintain statistical features while safeguarding privacy. Since the intricacy of AI algorithms might undermine legal structures, transparency is also essential. The study showed that business intelligence significantly improved the supply chain flexibility of the Nigerian consumer goods sector. As a result, firms should manage product diversity, utilise strategic IT alliances, implement structural flexibility, encourage SC integration, and place a strong emphasis on flexibility and information sharing. Stakeholders must also guarantee that SC flexibility is continuously improved. Businesses may maximise service performance, cut expenses, and adjust to changes in the market and disruptions by putting these methods into practice.

In line with the findings, supply chain resilience in the Nigerian consumer goods sector is influenced by business intelligence. In order to mitigate SC disruptions and enhance the industry's ability to adapt and rebound from such disruptions, stakeholders must utilise robotics in conjunction with blockchain-based system control. Traceability will be guaranteed by SCM systems controlled by blockchain technology. Processes like order fulfilment, inventory management, and transportation can all be automated with robotics. Potential advantages of robotics and blockchain technology integration include better efficiency, increased security, transparency, and real-time monitoring

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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