
SUPPLY CHAIN MANAGEMENT AND PERFORMANCE OF RUBBER PRODUCTION FIRMS: THE MODERATING ROLE OF INFORMATION TECHNOLOGY

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ABSTRACT

This investigated the role of IT in SCM within the rubber production industry. A descriptive research design was utilized. The population of the study comprised 62 staff of 4 firms operating in upstream sector of natural rubber production business in South-South Nigeria. A census was taken. 50 personnel in key positions from the companies were sampled. Primary data was collected using structured questionnaire. The study categorized SCM practices as low, moderate, and high, while IT deployment was rated as either high or low. The questionnaire underwent reliability test using Cronbach alpha coefficient, which yielded value of $\alpha = 0.871$. Descriptive statistics was used for data analysis. The findings revealed that performance of rubber production firms was highest when both SCM and IT deployment were categorized as high (mean = 28; SD = .00), compared to other levels of SCM and IT deployment. This result was confirmed by ANOVA, Scheffe's Post Hoc, and Eta squared, which produced statistically significant values (F-value (2.47) = 194.580; $p < .05$) when IT was considered moderator in the model. The Eta squared value of 0.892, indicated that IT accounted for 89.2% of the observed variance in the performance of the companies. The study concluded that IT significantly moderates the performance of SCM in the rubber production business.

Keywords: Information technology, organizational performance, rubber production, supply chain management

INTRODUCTION

The advent of information technology (IT) has significantly transformed business management approaches and processes; and has introduced viable alternatives and methods for effective administration of supply chain businesses. Magutu (2013) states that information technology has positive impact on production processes and has increased profitability of businesses. This observation is supported by Jadhav (2015), who affirms that IT facilitate smooth functioning of supply chains. A supply chain support the movement of products, information, and finances to enhance profitability of companies; and technology is pivotal to effective functioning of a supply chain (Mangan & Christopher, 2005).

The introduction of supply chain technology, a system that harmonizes and integrates the flow of information from source to end-user, has revolutionized supply chain processes, enabling efficient and effective transactions. It facilitates quick access to information, improves service delivery, ensures effective information flow, reduces paperwork, boosts productivity, and saves time (Magutu, 2013; Nor & Zulkifli, 2009). It is worth noting that supply chain technology is vital to organized manufacturing and operational processes, including logistics.

Technology driven supply chain management provides viable gains to firms over competitors in the market place. IT ranks as a major facilitator of business globally and its acclaimed efficiency has positively impacted production success and profitability (Ikeda & Marshall, 2016). Despite these benefits, rubber businesses in some parts of the world are still managed the traditional way. Manual record keeping is still largely practiced with its attendant drawbacks on supply chain performance (Jadhav, 2015). The effect of not embracing technology in supply chain management reflects in cost intensiveness and reduction in the capability of organization to compete favourably with other firms.

The non-deployment of IT in SCM in today's business world is a risk that must be avoided. The cost of uncertainty resulting from manual operations due to non-computerization could have wide implications for supply chain partners (Tarigan et al., 2021). Lack of information sharing among chain members is likely to cause a bullwhip effect where there is increase in order variance of the supply chain as demand information which passes through the supply chain is misused or misunderstood by the supplier. Inefficiencies arising from the bullwhip effect result in severe cost implications for supply chain members due to either excess raw materials or additional manufacturing expenses. Also, warehousing expenses and transportation cost need to be contended with (Marshall et al., 2016).

LITERATURE REVIEW

Theoretical Foundation

This study is premised on Network Theory (NT) which was developed in the late 1970s and 1980s; and which primarily focuses on the relationships between groups and long-term synergy they create within a value chain (Wellenbrock, 2013). NT provides explanations for comprehending supply chain management, elucidating the connections between organizations and customers.

According to Halldorsson et al. (2015), NT offers a broad perspective on inter-organizational connections in an interconnected environment, highlighting the significance of a networked setting and acknowledging the impact of business relationships on organizational operations. Hakansson (2015) and Harland (1996) assert that NT necessitates the configuration of actors, processes, and resources, which collectively form essential connective mechanisms.

Mikkola (2008) highlights that the interconnectivity of networks has the potential to generate shared information, enabling buyers and sellers to possess valuable insights and resources prior to engaging in strategic alliances. NT serves as a valuable approach for enhancing supply chain performance by establishing an organization-wide system for distributing information and facilitating administration (Miles & Snow, 2007).

Concept of Supply Chain Management

Blanchard (2021) notes that supply chains exist where two or more organizations are connected in the value creation process. These partners may be departments, divisions or groups in an organizational setting. Chen and Paulraj (2004) define supply chain as a set of connections of resources, information, and services conversion networks with the features of supply, shipment, and order. Supply chain management is an integrative approach concerned with the movement of unprocessed resources into a firm, an aspect of processing into processed goods as well as the transportation of the processed goods to the direct users.

Supply chain is an organized system of firms, individuals, processes, information, technology as well as resources, and concerned with the transportation of products from suppliers to customers (Njoku & Kalu, 2015). Palmer (2012) see supply chain management as the organization of raw resources and information resources in an organization to facilitate provision of services that drive customer satisfaction at all levels (Njoku & Kalu, 2015). Put differently, supply chain management is the incorporation of important organizational processes from primary suppliers to the final consumers, and the creation of added-value at each stage of the value chain (Nyangweso, 2013; Sillanpaa, 2010).

The overall goal is stabilization of cost and efficient and effective utilization of resources to facilitate organization's profitability. Croom et al. (2000) state that supply chain management is related to strategic management, associations and partnerships, logistics, best practices, marketing and organizational behaviour. This multi-disciplinary aspect of supply chain management makes it an all-embracing subject area and causing its important literature to be disjointed (Mentzer et al., 2001).

Organizational Performance

Organizational performance is described as organizational efforts toward accomplishing organizational goals through proper use of resources (Daft, 2015). Richardo and Wade (2001) state organizational performance involves the capability of a firm to attain predetermined goals. Organizational performance has always been seen as productivity; and this has suffered from conceptual and definition predicament in that manner (Hefferman & Flood, 2006).

While Richardo and Wade (2001) confirm that there was dissimilarity between productivity and firm's performance, they however noted that the former is concerned with the proportional representation of organization's activity carried out within specified time frame. Organizational performance however is broader in scope and includes productivity and other factors. In line with above, organizational performance is considered as both financial and non-monetary indicators which present information on the extent to which organizational objectives are met (Lebens & Euske, 2006).

Generally, it is believed that firms' accomplishment cuts across three important organization's outcomes: monetary, market and shareholders returns (Gavrea et al., 2011; Owen, 2006). Nevertheless, different dimensions adopted by scholars to ascertain performance include: improved profit, return on assets (ROA), gross profit, return on investments (ROI), return on sales (ROS), return on equity (ROE), sales growth, export growth, market share, stock price (Maduenyi *et al.*, 2015).

Information technology in SCM and performance

IT is seen as encompassing all aspects of technology primarily used for creation, capturing, manipulation, communication, swap, presentation and use of information in its different forms (Salo & Karjaluoto, 2006). Studies have confirmed the following as the objectives of IT in SCM: provision of information at rapid speed, accessibility of information beyond physical boundaries; facilitation of solitary spot of data on the bases of which decisions are made on the totality of supply chain information (Simchi-Levi et al., 2003).

However, the most important perceived function of IT in SCM is the reduction of abrasion and cost of information stream. IT essentially supports harmonization and cooperation of supply chain associated with IS. Jadhav (2015) notes that the aims of IT in SCM are: cost reduction in operation, enhanced information excellence through elimination of human mistakes and quick information transfer among firms.

There are several types of technology adoption in supply chain network. Each of these is expected to cause improvement in the firms' operational outcomes when properly associated with long term objectives. Patterson et al. (2003) are in agreement with the organization of SC technology and the grouping into functional and synergistic technologies. While the functional technologies support definite aspects of firms supply chain, the synergistic supply chain technology permits firms to interrelate with its associates within the supply chain (Magutu, 2013; Mukhtar et al., 2009).

Shavazi *et al.* (2009) are of the opinion that the use of information technology in supply chain management ensures significant decline in cycle time, decline in stock holding, reduction of variability between order and actual supply and ensures effective distribution channels. Generally, organizations that have utilized IT in SCM have the following merits: reduction in response time, business process redesign, streamlining of activities resulting in reduction in cost of operations and improved efficiency, development of high worth SC associations, improved services to customers and providing opportunity to secure international average and ultimately access to global market (Shavazi *et al.*, 2009).

Supply chain management, information technology and performance

Marinagi *et al.* (2014) study impact of IT on development of supply chain competitive advantage in manufacturing concerns in Greece. The study revealed that investment in IT maximizes outcomes specifically organization effectiveness and profitability. Also, Mashreghi *et al.* (2018) examined impact of IT on supply chain performance of vehicle manufacturers. The study found that appropriate dissemination of information yield improved processes efficiency as well as ease managerial processes. The findings also indicated that IT has a positive impact on supply chain performance.

Nyagawani (2013) examined impact of IT on SCM organization in Tanzanian Commission for AIDS (TACAIDS). The study was premised on effect of competence, efficacy, plasticity, accomplishment and receptiveness of information technology in supply chain management and assessment of functional areas of IT in SCM in TACAIDS. The study revealed that IT in SCM aids the rate of data adoption, information exchange and dissemination, and facilitates logistics to meet deadlines. Additionally, the finding showed that IT in SCM decreases turnaround time of transactions and lead to reduced cost.

Castorena *et al.* (2014) examined influence of information technology on organisational performance of SMEs manufacturing in Aguascalientes. The finding indicated that SCM that incorporate IT produces better results capable of improving control of human resources and records management. Similarly, Obeidat (2015) studied impact of IT on SCM in hospitals in Jordan. The results showed that investment in IT is crucial for cost management effectiveness; IT aids tracking of bills and preparation of suppliers payments. IT is essential for managing change processes effectively. It enhances communication frequency, improves monitoring of disease breakout as well as hospital administration.

Singhry (2016) examined IT and supply chain performance. The findings showed that considerable relationship exists between IT and supply chain performance; and concluded that there exist a significant association between IT and innovation capability and between innovation capability and supply chain performance. From the foregoing, it can be generalized that IT is essential to supply chain improvement and corporate performance. Therefore the study hypothesizes that:

Ho: Information technology does not moderate the relationship between supply chain management and performance of rubber production business.

METHODOLOGY

The study adopted descriptive research design. The population consisted 62 staff of 4 companies operating in the upstream sector of natural rubber production in South-south Nigeria. A census approach was used for the study. Procurement, processing, quality, stores, sales and marketing officers were sampled. The reason for sampling this category of staff is that they are directly involved in procurement, processing, and sales and marketing in their respective organizations, and are thus the most conversant with the problem of the research.

Primary data was obtained using structured questionnaire adapted from Chen and Paulraj (2004), Morgan and Hunt (1994); Cannon and Perreault (1999). The Cronbach Alpha coefficient was used to test for reliability. The reliability coefficient was $\alpha = 0.871$. Nenty and Umoinyang (2004) states reliability coefficients ranging from 0.59 and above for questionnaire are tenable and can yield reliable results. Preliminary analysis was done using simple percentages while the hypothesis was tested using ANOVA and Scheffe's Post Hoc test.

RESULTS

Table 2: Descriptive statistics of Information Technology as a moderator of SCM and organizational performance

Variable	Category	N	Mean	SD
Low SCM	Low deployment of IT	20	23.00	1.03
	High deployment of IT	0	0	0
Moderate SCM	Low deployment of IT	0	0	0
	High deployment of IT	10	26.00	.00
High SCM	Low deployment of IT	10	27.00	.00
	High deployment of IT	10	28.00	.00
Total	Low deployment of IT	30	24.33	2.09
	High deployment of IT	20	27.00	1.03
Total		50	25.40	2.18

Source: Field survey (2023)

Table 3: ANOVA of Information Technology as a moderator of SCM and performance

Source of variance	Sum of squares	df	Mean square	F-value	Sig.	Eta Squared
Between groups	207.000	2	103.500	194.580	.000	.892
Within groups	25.000	47	.532			
Total	232.000	49				

Source: Field survey (2023)

Table 4: Scheffe Post Hoc Test

(I) SCM	(J) SCM	Mean Difference (I-J)	Std. Error	Sig.
Low	Moderate	-3.00*	.25	.000
	High	-4.50*	.20	.000
Moderate	Low	3.00*	.25	.000
	High	-1.50*	.25	.000
High	Low	4.50*	.20	.000
	Moderate	1.50*	.25	.000

*significant at 95% confidence interval

Source: Field survey (2023)

Table 5: Homogeneous subsets

SCM	N	Subset for alpha =0.05		
		1	2	3
Low	20	23.00		
Moderate	10		26.0	
High	20			27.50
Sig.		1.00	1.00	1.00

Source: Field survey (2023)

Means for groups in homogeneous subsets are displayed.

Based on observed means.

The error term is Mean Square (Error) = .435.

a. Uses Harmonic Mean Sample Size = 15.000.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

c. Alpha = .05.

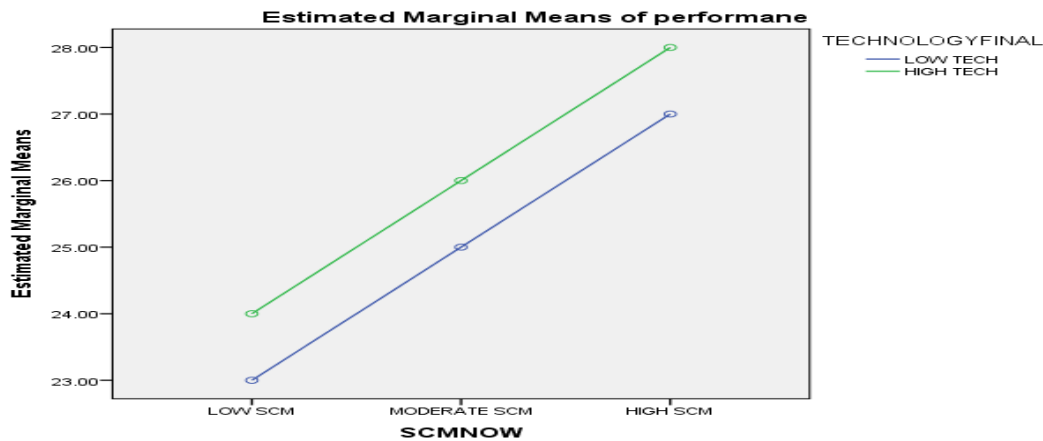


Fig. 1: Supply chain management and performance of rubber business, with IT as a moderating variable

The study categorized the independent variable, supply chain management, into three groups: low, moderate, and high practice. The moderating variable, information technology (IT), was divided into two groups: low and high deployment. The dependent variable was the performance of rubber production business, also referred to as organizational performance. Hypothesis testing was conducted using one-way analysis of variance (ANOVA) at a significance level of 0.05. The results of the analysis are presented in Tables 2 and 3, and the Scheffe Post Hoc test for multiple comparisons, along with a graphical representation of the statistically significant differences among the groups, is displayed in Table 4 and Fig. 1.

To categorize the respondents, their mean scores were utilized. Those with mean scores below the sample mean were classified as low supply chain management practice, those within the mean were classified as moderate supply chain management practice, and those above the mean were classified as high supply chain management practice. As shown in Table 2, out of the 50 respondents, 20 fell into the category of low supply chain management practice with low deployment of IT.

Ten respondents practiced moderate supply chain management with low IT deployment, while another ten respondents each practiced high supply chain management with low and high IT deployment, respectively. Based on the mean values, it can be observed that those who maximally practiced supply chain management and deployed high-level IT exhibited higher mean values, indicating better corporate performance of the rubber production business (Mean 28.0; SD = .00), compared to those who practiced supply chain management moderately and deployed high-level IT (Mean = 26.00; SD = .00).

Similarly, the results reveal that respondents who engaged in low supply chain management practice and deployed low-level IT had lower mean values (Mean = 23.00; SD = .00), indicating poorer performance. Thus, Table 3 demonstrates that the corporate performance of rubber businesses improves when supply chain management is maximally practiced with high-level IT deployment, while a contrasting outcome occurs when supply chain management is practiced moderately or minimally. This finding was further supported by the One-way analysis of variance (ANOVA) statistics presented in Table 3.

The ANOVA result shows statistical significant influence of IT (moderator) on supply chain management and performance of rubber production business (significant F-value (2.47) = 194.580; $p < .05$). Also, Eta squared test was done since the result was statistically significant and yielded Eta squared value of 0.892. (Eta squared range from zero to one which means perfect or strong association). The Eta squared value indicates that IT as a moderator accounted for 89.2% of the variance observed in the performance of rubber production business.

Since the F-test was statistically significant, Scheffe Post Hoc test was performed to establish which of the groups (low, moderate or high practice of supply chain management), improves corporate performance of rubber production business when information technology act as a moderating variable and the results are presented in Tables 4 and 5 (homogeneous subsets) to show the categories and graphical illustration in Figure 1.

Table 4 shows that the level of corporate performance of rubber production business when supply chain management is minimally practiced is statistically and significantly different from the level of corporate performance of rubber production business when supply chain management is practiced moderately (MD = -1.00; $p < .05$) and maximally (MD = -.05; $p < .05$).

This result implies that rubber production businesses that practice supply chain management maximally improve their corporate performance than rubber business that adopt SCM either moderately or minimally. Further results as displayed in Table 3 confirm that IT statistically and significantly moderate the relationship between SCM and performance of rubber production business. Respondents in each group were distinct, each in its sub-set signifying that, there was statistically significant difference between the groups. This could be due to the moderating variable.

The graphical illustration as shown in Figure 1 implies that the effect of the interaction between the independent variable and the dependent variable was influenced by the moderating variable. The graphs show that performance of rubber business is improved when high level IT is deployed. By these results, the hypothesis as stated that was rejected in favour of the alternate hypothesis, and conclusion that IT significantly moderates the relationship between supply chain management and performance of rubber production business in South-South Nigeria.

DISCUSSION OF FINDINGS

The findings of this study align with previous research conducted by Mashreghi (2018) and Marinagi et al. (2014), which demonstrated the impact of IT deployment on supply chain management and, consequently, organizational performance. These findings are also consistent with the studies conducted by Singhry (2016) and Nyagawani (2013), which revealed a significant relationship between IT and SC performance. Additionally, the present study corroborates the findings of Obeidat (2015) that IT plays a crucial role in various aspects of supply chain management, offering solutions to potential barriers that may hinder organizational performance.

The results are in line with the research conducted by Castorena et al. (2014), emphasizing the impact of IT on organizational performance. IT enables the coordination and collaboration of supply chain partners through efficient information dissemination, reducing conflicts, uncertainties, and disappointments, thereby enhancing the organization's ability to meet customer expectations. This, in turn, leads to increased customer satisfaction, loyalty, and patronage, all of which contribute to improved performance.

The implication of these findings is that when supply chain management is maximally practiced with high-level IT deployment, performance improves. Further research should explore the influence of the cost of IT deployment on the performance of rubber production businesses, as the cost factor is known to be a significant hindrance to organizations' ability to adopt IT solutions.

CONCLUSION

The study investigated the role of IT in supply chain management in rubber production business. From the investigation, it was concluded that IT considerably moderates the relationship between supply chain management and performance of rubber production business. IT has changed the way firms relate with their suppliers and customers, as well as influences the nature of information shared among supply chain partners.

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