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SUPPLY CHAIN INNOVATION AND OPERATIONAL EFFICIENCY OF FOOD AND BEVERAGE MANUFACTURING FIRMS IN SOUTH-SOUTH NIGERIA

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ABSTRACT: *This study explored supply chain innovation and operational efficiency of food and beverage manufacturing firms in South-South Nigeria. The study employed correlational research design and positivist research philosophy. The population of this study consisted of 85 registered food and beverage manufacturing firms in South-South Nigeria. A sample size of 48 firms was selected for the study using purposive sampling technique. The sampling units consisted of managers of the selected food and beverage manufacturing firms in South-South Nigeria. A structured questionnaire was used for data collection. The data collected were analyzed statistically while the hypotheses were tested using Spearman Rank Order Correlation Coefficient (rho) and SPSS software program version 24. The findings revealed that supply chain process innovation has a significant relationship with cost efficiency of food and beverage manufacturing firms in South-South Nigeria. This study also found a significant relationship between supply chain process innovation and time efficiency of food and beverage manufacturing firms in South-South Nigeria. The study equally revealed that supply chain technology innovation has a significant relationship with cost efficiency of food and beverage manufacturing firms in South-South Nigeria. The study also found a significant relationship between supply chain technology innovation and time efficiency of food and beverage manufacturing firms in South-South Nigeria. Based on these findings, it was concluded that supply chain innovation is capable of improving operational efficiency of food and beverage manufacturing firms in South-South Nigeria. Therefore, it is recommended that food and beverage manufacturing firms in Nigeria, particularly those that are experiencing operational inefficiency, should adopt supply chain innovation as it would improve operational efficiency.*

KEYWORDS: Supply chain innovation, supply chain process innovation, supply chain technology innovation, operational efficiency, cost efficiency, and time efficiency.

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INTRODUCTION

In a business environment where there is scarcity of resources, companies in the manufacturing sector need to improve their operational efficiency. Every company operates in a certain way and does numerous things to create products or services that will meet customer needs. However, if the operation of a company is not efficient, the company will be wasting its resources, such as time and money. Operational efficiency is highly essential for companies that are determined to achieve their goals and objectives. Legesse and Guo (2020) noted that companies with efficient operations are more productive, competitive and profitable. Thus, a more efficient operation will lower energy consumption, save costs, reduce waste and increase productivity of firms. Without operational efficiency, it will be difficult or impossible for companies to thrive in a resource constrained environment (Ifekanandu, 2024). Miencha and Selvan (2013) argued that inefficient operations can slow down a company's progress, increase costs, generate greater errors and decrease customer trust. Therefore, companies in the food and beverage manufacturing sector need to improve their operational efficiency in order to remain relevant and competitive in their industry. To improve operational efficiency, companies need to revisit their supply chain and apply emerging technologies and best practices at different stages of the supply chain. This can be done through the implementation of supply chain innovation.

Supply chain innovation is the implementation of new and improved strategies, technologies, processes and practices within the supply chain to enhance operational efficiency, reduce costs, mitigate risks, and improve overall performance (Jain, 2023). It involves significant changes in the elements along the supply chain that are meant to create value to end consumers. These changes involve the application of emerging technologies to optimize the end-to-end processes involved in the production, distribution and delivery of goods and services (Jain, 2023). Supply chain innovation leverages modern technologies, methods, data and best practices to create a more resilient, agile and sustainable supply chain. This type of innovation helps companies to optimize their processes, improve efficiency and achieve superior performance. Afraz et al. (2021) noted that companies that innovate their supply chain would have a competitive edge over their rivals and survive in a dynamic and complex environment.

Supply chain innovation is highly necessary for companies that operate a dynamic and competitive environment (Ifekanandu et al., 2024). However, a company that seeks to innovate its supply chain must define its goals and objectives, establish a cross-functional team, scan the environment, generate ideas, screen and evaluate each idea, test the selected ideas, select the subsets or specific locations that will pilot the implementation of the chosen idea or innovation, collect and analyze data to determine the innovation effectiveness in achieving the set objectives, iterate and refine the innovation based on the feedback or data collected, scale up the implementation across the broader supply chain network if the pilot phase is successful, monitor the progress and continuous improvement, and finally share the success or lesson learnt from the innovation process across the organization (Jain, 2023). By implementing supply chain innovation, companies can achieve a greater level of efficiency such as process efficiency, resource efficiency, cost efficiency, and minimize waste, optimize inventories, and ensure product availability and timely delivery of goods and services (Afraz et al., 2021). It is in light of the above that this study examines supply chain

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innovation and operational efficiency of food and beverage manufacturing firms in South-South Nigeria.

Statement of the Problem

One of the major challenges facing food and beverage manufacturing firms in Nigeria is how to achieve operational efficiency. Manufacturing firms in the Nigerian food and beverage sector operate in a resource constrained environment which requires them to be more efficient in their business operations. However, achieving operational efficiency has remained a challenging task for these companies. Many manufacturing firms in the food and beverage sector in Nigeria are still struggling to reduce operational costs and complete tasks within the shortest possible time, resulting in operational inefficiency. These firms are finding it difficult to maximize profit due to operational inefficiency. To improve their operational efficiency, some food and beverage manufacturing firms have reviewed their supply chain operations by integrating some degree of newness in the way their supply chain operations are executed. These firms have introduced new technologies into their supply chain operations and streamlined their supply chain processes to improve operational efficiency. However, ever since these companies innovated their supply chain network including their supply chain processes and technologies, it is still not clear whether such strategic move has improved their operational efficiency, as empirical studies that examined supply chain innovation and operational efficiency in the food and beverage manufacturing firms in Nigeria are absent. This gap in literature is what this study is motivated to bridge.

Conceptual Framework

The conceptual framework of supply chain innovation and operational efficiency is shown in Figure 1 below:

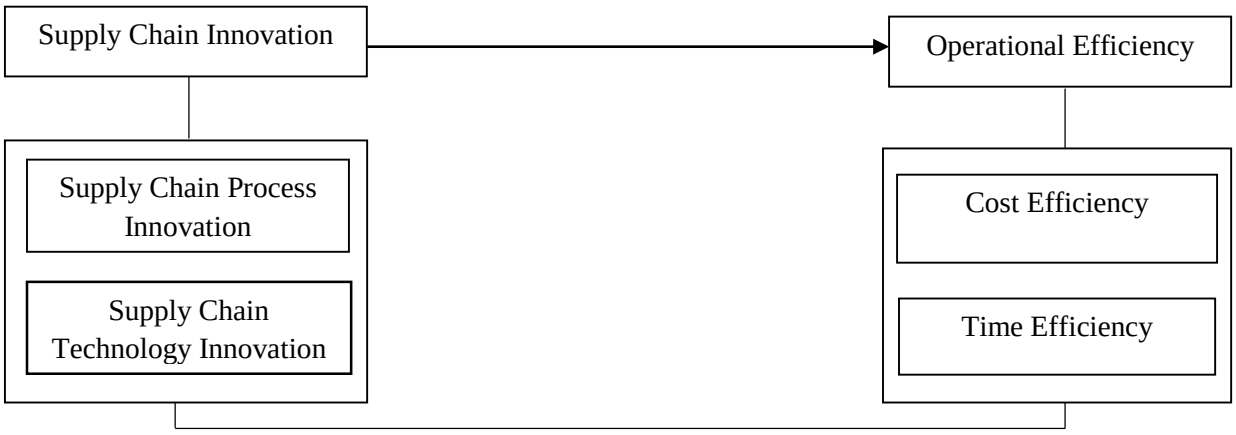

Fig. 1: Conceptual framework of supply chain innovation and operational efficiency of food and beverage manufacturing firms

Source: *Author's Conceptualization*

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Aim and Objectives of the Study

This study is aimed at examining the relationship between supply chain innovation and operational efficiency of food and beverage manufacturing firms in South-South, Nigeria. The objectives of the study are to:

1. ascertain the relationship between supply chain process innovation and cost efficiency of food and beverage manufacturing firms in South-South, Nigeria;
2. determine the relationship between supply chain process innovation and time efficiency of food and beverage manufacturing firms in South-South, Nigeria;
3. ascertain the relationship between supply chain technology innovation and cost efficiency of food and beverage manufacturing firms in South-South, Nigeria;
4. explore the relationship between supply chain technology innovation and time efficiency of food and beverage manufacturing firms in South-South, Nigeria.

Research Questions

Attempts were made to answer the following research questions:

1. What is the relationship between supply chain process innovation and cost efficiency of food and beverage manufacturing firms in South-South, Nigeria?
2. How does supply chain process innovation relate to time efficiency of food and beverage manufacturing firms in South-South, Nigeria?
3. What is the relationship between supply chain technology innovation and cost efficiency of food and beverage manufacturing firms in South-South, Nigeria?
4. To what extent does supply chain technology innovation relate to time efficiency of food and beverage manufacturing firms in South-South, Nigeria?

Research Hypotheses

The following hypotheses were formulated in this study:

H_{o1}: There is no significant relationship between supply chain process innovation and cost efficiency of food and beverage manufacturing firms in South-South, Nigeria.

H_{o2}: There is no significant relationship between supply chain process innovation and time efficiency of food and beverage manufacturing firms in South-South, Nigeria.

H_{o3}: There is no significant relationship between supply chain technology innovation and cost efficiency of food and beverage manufacturing firms in South-South, Nigeria.

H_{o4}: There is no significant relationship between supply chain technology innovation and time efficiency of food and beverage manufacturing firms in South-South, Nigeria.

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REVIEW OF RELATED LITERATURE

Concept of Supply Chain Innovation

A supply chain connotes the channel, process or network which goods or services go through before they get to the end users. It represents the necessary steps taken by a company to deliver a product or service to customers (Supply Chain Council in Abderrazak & Dhiba, 2022). However, an innovation that takes place along or within the supply chain of a company is known as a supply chain innovation. Arlbjorn in Abderrazak and Dhiba (2022) defined supply chain innovation as a change (incremental or radical) within a supply chain network, supply chain technology, or supply chain process (or a combination of these) that can take place in a company function, within a company, in an industry or in a supply chain in order to enhance new value creation for the stakeholders. Singhry et al. (2014) defined supply chain innovation as the reconfiguration and integration of the internal and external processes, structure and infrastructure of a company with the aim of sensing and seizing new opportunities that facilitate information management, sourcing, production and delivery of products to end-consumer in a responsive, cost efficient and timely manner. Seo and Mason (2015) stated that supply chain innovation requires technological and process innovation within the supply chain of a company to improve service delivery and meet customer requirements.

Supply chain innovation is aimed at providing new, effective and innovative solutions for end users by dealing with uncertainties and disruptions in the internal and external environments (Mehregan et al., 2023). With the rapid changes in market trends, supply chain innovation can help companies to respond quickly to changing market trends, improve service delivery and increase customer satisfaction level (Ifekanandu et al., 2024). Afraz et al. (2021) posited that innovative supply chain is highly essential for companies because it helps them to adjust business strategies within their supply chain and improve their competitiveness. Lee et al. (2011) opined that supply chain innovation helps companies to reduce their operational costs and lead time, and enhances their flexibility in responding to the rapid changes in market or customer demand. Tarafdar and Qrunfleh (2017) argued that companies need to innovate their supply chain in order to meet the changing needs of customers. To support this position, Wong et al. (2019) noted that companies that innovate their supply chain take into consideration the demands of customers to improve the supply chain processes and performance.

Dimensions of Supply Chain Innovation

Supply chain innovation is a multidimensional construct that cuts across different areas of innovation. According to Rogers in Kwak et al. (2017), supply chain innovation occurs within processes, technologies, services, strategies, networks and structures. Malacina and Teplov (2022) opined that supply chain innovation is viewed in terms of adopting new processes, new technological systems and new operational routines within the chain. However, the dimensions of supply chain innovation considered in this study are supply chain process innovation and supply chain technology innovation.

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Supply Chain Process Innovation

A supply chain process is the step-by-step procedure which is followed by a company in delivering a product or service to the end user (Khan, 2018). This supply chain process consists of five steps such as plan, source, make, deliver and return process (Khan in Abderrazak & Dhiba, 2022). Nazari-Shirkouhi in Mehregan et al. (2023) stated that the supply chain process commences with the procurement of raw materials based on the specific requirements of the customer and culminates with the transportation and delivery of the finished product to the customer. However, significant transformations, modifications or changes in the supply chain processes of a company are known as supply chain process innovation (Malacina & Teplov, 2022). Wagner in Kwak et al. (2017) posited that supply chain process innovation is the implementation of new and improved techniques, methods and procedures within a company's supply chain with the aim of continuously improving the quality of service delivery and reducing operational costs. It focuses on operational issues that revolve around sorting for new methods of procurement, manufacturing, distribution and delivery of products to customers. Ifekanandu (2024) noted that companies often look for new ways to source for raw materials and to manufacture, deliver and return certain products. These new ways to source for raw materials, manufacture, deliver and return (recover) products (supply chain process innovation) are met to improve service delivery. Afraz et al. (2020) opined that innovative supply chain processes are critical in achieving business success. A good number of companies have innovated different aspects or stages of their supply chain. For instance, Cisco made radical innovations in supply chain processes by creating a whole new business model for handling product returns (Arlbjorn et al. in Heikkinen, 2023).

Supply Chain Technology Innovation

Supply chain technology innovation is the application of new and advanced technology at different stages of the supply chain of a company with the aim of ensuring timely and cost-effective delivery of goods and services to customers (Arlbjorn et al., 2011). New supply chain technology consists of advanced manufacturing technology and information technology that are used in supply operations (Naseem & Yang, 2021). Kwak et al. (2017) noted that technology innovation across the supply chain of a company comes in the form of an integrated information system, real-time tracking technology and innovative logistics equipment. However, Rad et al. (2022) posited that the specific advanced technologies applied across the supply chain include additive manufacturing, big data technologies, artificial intelligence, blockchain technology, cloud computing, augmented reality, manufacturing robotics, automation, 3D printing, stimulation, semantic technologies and Internet of Things (IoT). With real-time technology, companies can have a clear visibility regarding the flow of cargoes and information to the final consumers (Afraz et al., 2021). Malacina and Teplov (2022) opined that the application of technologies such as GPS, RFID and ERP can help companies to monitor inventories and cargoes in transits, and manage risks along their supply chain.

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Concept of Operational Efficiency

According to Legesse and Guo (2020), operational efficiency is the ability of a company to produce the same quantity and quality of products (output) with limited resources (inputs). It indicates how well a company utilizes fewer materials, labour, capital and time to produce the same volume of output. Baik et al. (2013) stated that operational efficiency is achieved when a company is able to reduce its costs and minimize waste in the course of producing quality products. The more efficient a company is, the more profitable it becomes (Miencha & Selvan, 2013). By manufacturing products at lower cost, companies tend to achieve higher profit margin (Guo & Legesse, 2020). Santosuosso (2014) posited that efficient organizations produce quality products with limited time and money. Such organizations produce more products using the same number of workforce and machines. Improving organizational efficiency requires firms to identify areas of waste and other processes that are not needed (Gill et al., 2014). By eliminating areas of wasted effort as well as other unnecessary processes, companies can be able to reduce their operational costs and achieve operational efficiency (Gill et al., 2014).

Measures of Operational Efficiency

Operational efficiency can be measured using various indicators. However, in this study, operational efficiency is measured using cost efficiency and time efficiency.

Cost Efficiency

Cost efficiency refers to the degree to which a company is able to minimize its operating costs while producing or maintaining the same level of output (Baik et al., 2013). It indicates how well financial resources are used to achieve the desired output. Guo et al. (2020) described cost efficiency as the ability of a company to change its work processes to save costs without reducing the quantity of output. Lotto (2018) posited that cost efficiency can be achieved by eliminating unnecessary costs, streamlining work processes (including the automation of unnecessary processes) and increasing worker efficiency across all departments and units. Cost efficiency is very important to companies because it guarantees profitability. James et al. (2023) stated that companies need to be cost efficient in order to thrive and survive in a resource constrained environment. Azad et al. (2018) opined that companies need to reduce their operational costs, such as cost of raw materials, labour and overhead expenses, so that they can produce products that are affordable to the low-income population and maximize profit.

Time Efficiency

Time efficiency is a key indicator used to determine operational efficiency of a firm. According to Santosuosso (2014), time efficiency is the ability of a person or firm to complete a given task or activity within the shortest possible time without wasting resources. It indicates how well a person or firm utilizes its time to deliver the expected result. Lotto (2018) defined time efficiency as a firm's ability to accomplish tasks within a limited timeframe while also maintaining the same level of output. Thus, a company can be said to be time efficient if it produces the desired results within the shortest possible time without wasting resources (Legesse & Guo, 2020). James et al. (2023) noted that a time efficient firm knows how to schedule and allocate tasks so that it can get things

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done within the timeframe given by customers. Such a firm often tries new ways of doing things to save time and maintain quality output. However, automating repetitive tasks can help a firm to save time and maintain quality output (Azad et al., 2018). Gill et al. (2014) stated that a firm can accomplish more within a given timeframe by optimizing its processes, minimizing distractions and eliminating unnecessary procedures.

Theoretical Review

This study utilized the diffusion of innovation theory to explain how innovation spreads across the supply chain of firms. Diffusion of innovation theory describes the speed at which new ideas, new technologies and new business practices spread across different societies. The theory argues that the key players behind the wider spread of innovation across modern societies are the innovators, early adopters, early majority, late majority and the laggards. According to the theory, the innovators are those people who take risks and try new ideas; the early adopters are those people who show interest in trying the new ideas and create societal utility; the early majority comprises of those people who encourage the use of the new invention or innovation within the mainstream society; the late majority consists of those who immediately follow the early majority that have adopted the innovation in their daily routine; while the laggards are those (risk-averse) who lag behind the population that have adopted the new ideas or innovation. The diffusion of innovation theory is very useful in explaining how innovation spreads across the supply chain of manufacturing firms. The theory explains that some manufacturing firms are innovators, early adopters and early majority while others are late majority and laggards when it comes to adopting supply chain innovation. While manufacturing firms that are innovators, early adopters and early majority gain first mover advantage to improve their operational efficiency, the late majority and laggard rivals benefit less from such strategic moves.

Empirical Review

Previous studies have been conducted on supply chain innovation of firms in developed and developing countries. For instance, Joshi et al. (2023) critically assessed supply chain innovations for building resilient food supply chains. Their study adopted the survey research design where data were collected from 20 professionals (specialists) and managers of agri-food firms in Northern India using standardized questionnaires. The data collected were analyzed using graphs and pie charts while the Multi-Criteria Decision Making (MCDM) and the Stepwise Weight Assessment Ratio Analysis (SWARA) were used to identify the preferred methods for constructing the resilient food supply chain. The results from the SWARA show that business strategy innovations are the most significant innovations that can bring resilience to the food supply chains, followed by technological innovations.

Vernosfaderani (2021) investigated the impact of supply chain innovation on performance with the mediating role of strategic agility. The researcher employed the survey research design and used a structured questionnaire to collect data from 70 managers and employees in the food industry in Tehran. The data collected were analyzed using descriptive statistics such as mean and standard deviation while the hypotheses and model were tested using the least squares method and SMART PLS. The findings revealed that supply chain innovation has a positive effect on firm

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performance, and that strategic agility plays a mediating role in the relationship between supply chain innovation and firm performance.

Karami et al. (2014) carried out a study to determine the impact of supply chain innovation and competitive advantage on perceived organizational performance. Their study adopted the cross-sectional survey research design where a structured questionnaire was used to collect data from owners of industrial manufacturing firms in Peninsular Malaysia. After analyzing the data collected from the respondents, the researchers found out a positive relationship between supply chain innovation and industrial manufacturing performance. The study also revealed that competitive advantage moderates the relationship between supply chain innovation and organizational performance.

Rasib et al. (2021) conducted a study to ascertain how competitive advantage fosters supply chain innovation. Their study employed the survey research design and the quantitative research approach where a self-administered questionnaire was used to obtain data from senior managers in operational departments in manufacturing firms in Malaysia. The researchers used a structured questionnaire to obtain data from the respondents. The data collected were analyzed statistically using the SPSS software program. The findings showed that competitive advantage significantly motivates manufacturing firms to implement supply chain innovation.

Heikkinen (2023) examined supply chain innovation and supplier innovativeness in global, multi-industrial companies. The researcher adopted the case study research design and the qualitative research approach where semi-structured interview was used to collect data from individuals who have held positions as heads of supply chain in large and global companies that operate as developers and suppliers in multiple industrial sectors. The data collected from the respondents (interviewees) were analyzed using qualitative content analysis. The findings revealed that supply chain innovation and supplier innovativeness relationship is acknowledged in large and global companies with a positive attribute of attractiveness.

Kwak et al. (2017) explored the relationship between supply chain innovation, risk management capabilities and competitive advantage in global supply chains. The study employed survey research design where a structured questionnaire was used to collect data from South Korean manufacturers and logistics intermediaries involved in global supply chain operations. The Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM) were used to analyze the data collected from the respondents. The findings revealed that innovative supply chains significantly enhance risk management capability and build a competitive advantage of firms in the global supply chain.

Singhry (2015) examined supply chain innovation and performance of manufacturing companies. Their study adopted the cross-sectional survey research design where a structured questionnaire was used to elicit data from 292 managers of manufacturing companies in Nigeria. The data collected were analyzed using descriptive statistics such as percentage and frequency analysis while the confirmatory factor analysis and structural equation modeling (Amos) were used to test the hypotheses and the model. The findings showed that supply chain innovation (advanced manufacturing technology, collaborative processes, top management support and innovation

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capability) has a significant relationship with supply chain performance of manufacturing companies in Nigeria.

Gap in Literature

From the empirical literature, it is confirmed that a significant number of studies have been conducted on supply chain innovation among firms in different countries of the world. However, most of the studies conducted on supply chain innovation relate the concept to organizational resilience, firm performance, competitive advantage, risk management capabilities and supplier innovativeness while studies that examined the relationship between supply chain innovation and operational efficiency of food and beverage manufacturing firms in Nigeria are absent. This has created a vacuum in literature that this study intends to fill.

METHODOLOGY

This study is a correlational research that utilizes the positivist research philosophy. The study population comprised 85 registered food and beverage manufacturing firms in South-South Nigeria (https//:www.directory.org.ng). These firms are spread across the six states that make up the South-South Geopolitical Zone of Nigeria, namely, Akwa Ibom State, Cross River State, Delta State, Edo State, Bayelsa State and Rivers State. A sample size of 48 food and beverage manufacturing firms were selected purposively based on the criteria that they have implemented innovation across different stages of their supply chain. The sampling units consisted of managers of the selected food and beverage manufacturing firms in South-South Nigeria. The managers include strategic managers, operational managers, production managers, R&D managers and innovation managers. A sample of 240 managers was drawn from the 48 selected firms on the ratio of 5 managers per company. The data were collected from the respondents using a structured questionnaire which was designed on a 4-point rating scale such as Strongly Agree, Agree, Disagree and Strongly Disagree. The instrument for data collection was validated through content analysis while its reliability was determined using Cronbach Alpha method. After a validity and reliability test, 240 copies of the questionnaire were administered to the respondents and 217 copies were collected. Statistical analysis was conducted on the data collected while Spearman Rank Order Correlation Coefficient (rho) was used to test the hypotheses. The statistical analysis was aided with the application of the SPSS 24.0 version.

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RESULTS AND DISCUSSION

The results of the bivariate analysis conducted on the study variables are shown in the tables below:

Table 1: Result of bivariate analysis between supply chain process innovation and cost efficiency of food and beverage manufacturing firms

			Supply Chain Process Innovation	Cost Efficiency
Spearman Rank (rho)	Supply Chain Process Innovation	Correlation Coefficient	1.000	.756**
		Sig. (2 tailed)	.	.001
		N	217	217
	Cost Efficiency	Correlation Coefficient	.756**	1.000
		Sig. (2 tailed)	.001	.
		N	217	217

**Correlation is significant at 0.01 levels (2 tailed)
*Correlation is significant at 0.05 levels (2 tailed)

Source: *SPSS-Generated Output*

Table 1 shows that supply chain process innovation is strongly and positively correlated to cost efficiency of food and beverage manufacturing firms (rho = .756**) and this correlation is statistically significant at 0.01 level. Based on this result, the null hypothesis (Ho_1) is rejected and the alternate hypothesis is accepted. This means that we then accept that there is a significant relationship between supply chain process innovation and cost efficiency of food and beverage manufacturing firms in South-South Nigeria.

Table 2: Result of bivariate analysis between supply chain process innovation and time efficiency of food and beverage manufacturing firms

			Supply Chain Process Innovation	Time Efficiency
Spearman Rank (rho)	Supply Chain Process Innovation	Correlation Coefficient	1.000	.688**
		Sig. (2 tailed)	.	.001
		N	217	217
	Time Efficiency	Correlation Coefficient	.688**	1.000
		Sig. (2 tailed)	.001	.
		N	217	217

**Correlation is significant at 0.01 levels (2 tailed)
*Correlation is significant at 0.05 levels (2 tailed)

Source: SPSS-Generated Output

Table 2 reveals that supply chain process innovation has a strong and positive correlation with time efficiency of food and beverage manufacturing firms (rho = .688**) and this correlation is statistically significant at 0.01 level. As a result of this, we then reject the null hypothesis (Ho_2) and accept the alternate hypothesis which states that there is a significant relationship between

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supply chain process innovation and time efficiency of food and beverage manufacturing firms in South-South Nigeria.

Table 3: Result of bivariate analysis between supply chain technology innovation and cost efficiency of food and beverage manufacturing firms

			Supply Chain Technology Innovation	Cost Efficiency
Spearman Rank (rho)	Supply Chain Technology Innovation	Correlation Coefficient	1.000	.758**
		Sig. (2 tailed)	.	.001
		N	217	217
	Cost Efficiency	Correlation Coefficient	.758**	1.000
		Sig. (2 tailed)	.001	.
		N	217	217

**Correlation is significant at 0.01 levels (2 tailed)
*Correlation is significant at 0.05 levels (2 tailed)

Source: SPSS-Generated Output

Table 3 indicates that supply chain technology innovation is strongly and positively correlated to cost efficiency of food and beverage manufacturing firms (rho = .758**) and this correlation is statistically significant at 0.01 level. Consequently, the null hypothesis (Ho_3) is rejected and the alternate hypothesis is accepted. This means that we then accept that there is a significant relationship between supply chain technology innovation and cost efficiency of food and beverage manufacturing firms in South-South Nigeria.

Table 4: Result of bivariate analysis between supply chain technology innovation and time efficiency of food and beverage manufacturing firms

			Supply Chain Technology Innovation	Time Efficiency
Spearman Rank (rho)	Supply Chain Technology Innovation	Correlation Coefficient	1.000	.816**
		Sig. (2 tailed)	.	.001
		N	217	217
	Time Efficiency	Correlation Coefficient	.816**	1.000
		Sig. (2 tailed)	.001	.
		N	217	217

**Correlation is significant at 0.01 levels (2 tailed)
*Correlation is significant at 0.05 levels (2 tailed)

Source: *SPSS-Generated Output*

Table 4 shows a very strong and positive correlation between supply chain technology innovation and time efficiency of food and beverage manufacturing firms (rho = .816**) and this correlation is statistically significant at 0.01 level. Based on this result, the null hypothesis (Ho_4) is rejected and the alternate hypothesis is accepted. This implies that we then accept that there is a significant

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relationship between supply chain technology innovation and time efficiency of food and beverage manufacturing firms in South-South Nigeria.

DISCUSSION OF FINDINGS

This study discovered a significant relationship between supply chain process innovation and cost efficiency of food and beverage manufacturing firms in South-South Nigeria. This finding was derived from the result of the statistical analysis carried out on the two variables (supply chain process innovation and cost efficiency). The result revealed that supply chain process innovation is strongly and positively correlated to cost efficiency of food and beverage manufacturing firms (rho = .756**) and this correlation is statistically significant at 0.01 level. Based on this result, the null hypothesis (Ho_1) was rejected and the alternate hypothesis was accepted. This means that we then accepted that there is a significant relationship between supply chain process innovation and cost efficiency of food and beverage manufacturing firms in South-South Nigeria. This finding is supported by Arlbjorn et al. (2011) and Yuan et al. (2019) as both studies revealed that innovative supply chain processes reduce operational costs of manufacturing firms.

This study also discovered a significant relationship between supply chain process innovation and time efficiency of food and beverage manufacturing firms in South-South Nigeria. This finding emanated from the result of the statistical analysis carried out on the two variables (supply chain process innovation and time efficiency). The result revealed that supply chain process innovation has a strong and positive correlation with time efficiency of food and beverage manufacturing firms (rho = .688**) and this correlation is statistically significant at 0.01 level. As a result of this, we then rejected the null hypothesis (Ho_2) and accepted the alternate hypothesis which states that there is a significant relationship between supply chain process innovation and time efficiency of food and beverage manufacturing firms in South-South Nigeria. This finding is consistent with the findings of Lee et al. (2011) and Ageron et al. (2013) which revealed that process innovation along the supply chain enables companies to complete tasks on-time and improve their internal efficiency.

This study found a significant relationship between supply chain technology innovation and cost efficiency of food and beverage manufacturing firms in South-South Nigeria. This finding was deduced from the result of the statistical analysis carried out on the two variables (supply chain technology innovation and cost efficiency). The result revealed that supply chain technology innovation is strongly and positively correlated to cost efficiency of food and beverage manufacturing firms (rho = .758**) and this correlation is statistically significant at 0.01 level. Consequently, the null hypothesis (Ho_3) was rejected and the alternate hypothesis was accepted. This means that we then accepted that there is a significant relationship between supply chain technology innovation and cost efficiency of food and beverage manufacturing firms in South-South Nigeria. This finding is supported by Seo et al. (2014) and Malacina and Teplov (2022) who reported that new supply chain technology enables firms to eliminate unnecessary operational costs and increase profitability.

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Finally, it was discovered that supply chain technology innovation has a significant relationship with time efficiency of food and beverage manufacturing firms in South-South Nigeria. This finding was deduced from the result of the statistical analysis carried out on the two variables (supply chain technology innovation and cost efficiency). The result showed a very strong and positive correlation between supply chain technology innovation and time efficiency of food and beverage manufacturing firms (rho = .816**) and this correlation is statistically significant at 0.01 level. Based on this result, the null hypothesis (Ho_4) was rejected and the alternate hypothesis was accepted. This implies that we then accepted that there is a significant relationship between supply chain technology innovation and time efficiency of food and beverage manufacturing firms in South-South Nigeria. Seo and Mason (2015) and Rad et al. (2022) agreed with this finding as both studies revealed that innovative supply chain technology saves time and improves organizational efficiency.

CONCLUSION

This study examined supply chain innovation and operational efficiency of food and beverage manufacturing firms in South-South Nigeria. It focused on supply chain process innovation and supply chain technology innovation and related them to operational efficiency, such as cost efficiency and time efficiency of food and beverage manufacturing firms. The result of the analysis revealed that supply chain process innovation is significantly related to operational efficiency (cost efficiency and time efficiency) of food and beverage manufacturing firms in South-South Nigeria. The study also revealed that supply chain technology innovation is significantly related to operational efficiency (cost efficiency and time efficiency) of food and beverage manufacturing firms in South-South Nigeria. Based on these findings, it was concluded that supply chain innovation (supply chain process innovation and supply chain technology innovation) significantly enhances the operational efficiency of food and beverage manufacturing firms in South-South Nigeria.

RECOMMENDATIONS

The following recommendations are provided based on the findings:

1. Food and beverage manufacturing firms in Nigeria, particularly those that are experiencing operational inefficiency, should adopt supply chain innovation as it would improve operational efficiency.

2. Food and beverage manufacturing firms in Nigeria should innovate their supply chain processes and eliminate unnecessary processes as it would not only save costs and time but would also improve their organizational efficiency.

3. Food and beverage manufacturing firms in Nigeria should automate their repetitive processes and streamline their operations as this would help to reduce unnecessary costs and save productive time.

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4. Food and beverage manufacturing firms in Nigeria should adopt new technologies such as additive manufacturing, big data technologies, artificial intelligence, blockchain technology, cloud computing, augmented reality, manufacturing robotics, automation, 3D printing, stimulation, semantic technologies and Internet of Things (IoT) in their supply chain as it would improve their operational efficiency.

5. Finally, food and beverage manufacturing firms in Nigeria should innovate their supply chain network by ensuring that all stages of their supply chain are automated as it would not only ensure time efficiency but also guarantee cost efficiency.

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