



## LOGISTICS TECHNOLOGY ADOPTION AND DELIVERY PERFORMANCE OF SHIPPING COMPANIES IN SOUTH-WEST NIGERIA

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**ABSTRACT:** *This study explored logistics technology adoption and delivery performance of shipping companies in South-West Nigeria. The study used a positivist research philosophy and correlational design to analyse data from 65 shipping companies in South-West Nigeria, with 20 managers selected purposefully and a structured questionnaire used as the primary instrument. The data collected were analysed using descriptive statistics while the Pearson Product Moment Correlation Coefficient (PPMCC) was used to test the formulated hypotheses. SPSS software program version 24 was used to perform the bivariate analysis. The findings revealed that Artificial intelligence adoption has a significant relationship with on-time delivery of shipping companies. The study showed a significant correlation between the adoption of Artificial intelligence, transportation technology, and warehouse automation, as well as the on-time delivery of shipping companies. The study concluded and recommended that adopting logistics technology can significantly enhance the delivery performance of shipping companies in South-West Nigeria.*

**KEYWORDS:** Logistics technology adoption, artificial intelligence, transportation technology, warehouse automation, and delivery performance.



## INTRODUCTION

In a dynamic and competitive environment, there is a need for logistics firms to adopt modern technology in order to improve their delivery performance and remain relevant in the industry. Shipping companies in Nigeria operate in a dynamic and competitive environment, and as such they need to keep pace with the developments in the industry. Technology adoption is one of the remarkable developments that have taken place in the logistics industry. Okwubali et al. (2023) noted that technology has transformed how logistics services are provided. It has revolutionised the logistics industry and made logistics operations more efficient and productive. However, the technology designed for logistics operations is known as logistics technology. According to Moore (2021), logistics technology is the creation of novel scientific methods and procedures implemented into practical tools and applications to help adopters and organisations seize significant opportunities in the logistics industry, address issues and mitigate environmental risks (Moore, 2021). Goldsby and Zinn (2016) described logistics technology as the application of technology to improve the logistics operations of a firm. Logistics technology is designed to help logistics firms meet customer requirements, resolve issues and achieve the objectives of their organisation (Nagarajan & White, 2017).

New logistics technologies reflect the development of society, business and technological trends (Oksana & Yevhen, 2019). For instance, telematics emerge as a result of technological advancement in the fields of satellite navigation, digital mapping and telecommunications (Mena et al., 2017). Telematics covers a wide range of applications including tracking and tracing applications, routing and mapping applications, geofencing applications, and advanced traffic management applications (Mena et al., 2017). These technologies play a key role in the logistics industry as they enable firms to meet customer needs or requirements, resolve logistics issues and accomplish goals. It brings about operational change, reduces the costs of operations and improves service delivery (Jahre & Fabbe-Costes, 2015). Tapscott and Tapscott (2017) opined that logistics firms need to make significant investments in new technology to stay alive, expand their footprint, and sustain their market share. However, Sipos and Bizoi (2015) argued that logistics companies should not adopt modern technology just for the sake of adoption rather they should consider the cost and benefits of utilising modern technology to ensure that such a move is not counter-productive.

The adoption of logistics technology is capable of improving the delivery performance of shipping firms. According to Oksana and Yevhen (2019), the application of logistics technology would lead to operational efficiency, improved service delivery, higher profit, cost reduction, greater flexibility and improved competitiveness. Blecker et al (2014) observed that logistics firms that possessed more advanced technology usually enjoyed greater efficiency and market success. According to them, the adoption of logistics technology improves logistics operations and reduces operational costs. Bienstock et al. (2018) noted that the application of new logistics technologies gives a company more flexibility, improves service delivery, saves costs and guarantees operational efficiency. Edward in Okwubali et al. (2023) argued that logistics technology gives a firm the needed stability and growth, enabling it to take big steps, get an advantage over rivals and improve its delivery performance. It is against this backdrop that this study examines the relationship between logistics technology adoption and delivery performance of shipping companies in South-West Nigeria.

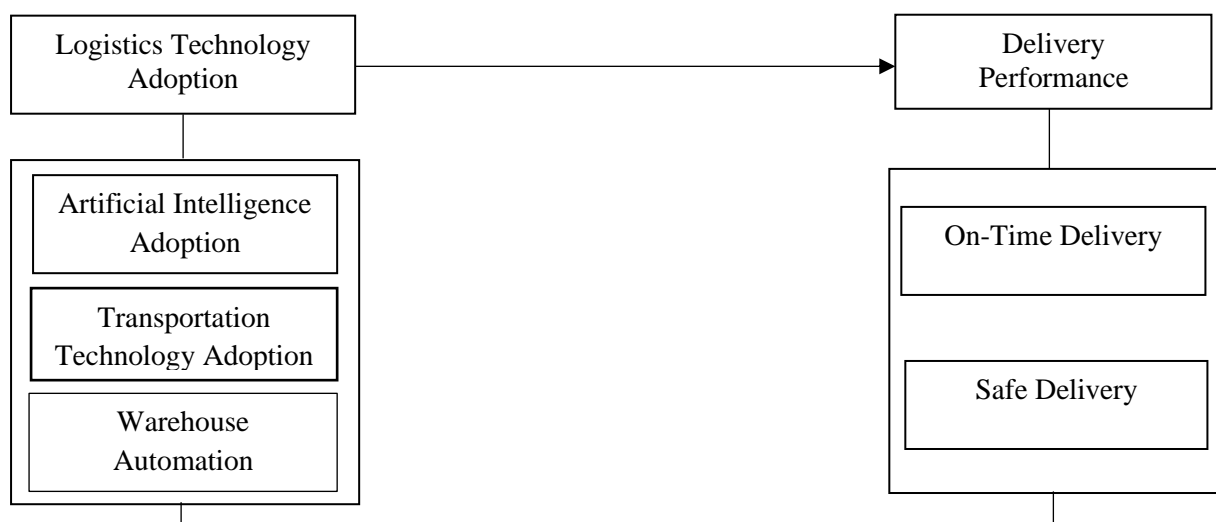


## Statement of the Problem

One of the main challenges confronting shipping companies in Nigeria is how to improve their delivery performance. Many shipping companies are struggling to deliver goods in a safe and timely manner. Some of these companies often fail to deliver goods on the scheduled date while others deliver products on time but in a very poor condition, thereby resulting in poor delivery performance. A good number of shipping companies in Nigeria have ceased operations due to poor delivery performance. The poor delivery performance of shipping companies over the years could be attributed to their inability to adopt logistics technology in their operations. Recently, some shipping companies in Nigeria have come to realise the importance of technology and have adopted logistics technology in their daily operations. However, ever since these companies adopted logistics technology in their operations, it is still not clear whether it has improved their delivery performance as empirical studies that examined the relationship between logistics technology adoption and delivery performance of shipping companies in Nigeria are absent, hence, the need for this study.

## CONCEPTUAL FRAMEWORK

The conceptual framework of logistics technology adoption and delivery performance is shown in Figure 1 below:



**Fig 1:** Conceptual framework of logistics technology adoption and delivery performance of shipping companies



## **Aim and Objectives of the Study**

The aim of this study is to examine the relationship between logistics technology adoption and delivery performance of shipping companies in South-West Nigeria. The specific objectives of the study are to:

1. ascertain the relationship between artificial intelligence adoption and on-time delivery performance of shipping companies in South-West Nigeria;
2. determine the relationship between artificial intelligence adoption and safe delivery performance of shipping companies in South-West Nigeria;
3. explore the relationship between transportation technology adoption and on-time delivery performance of shipping companies in South-West Nigeria;
4. ascertain the relationship between transportation technology adoption and safe delivery performance of shipping companies in South-West Nigeria;
5. explore the relationship between warehouse automation and on-time delivery performance of shipping companies in South-West Nigeria;
6. determine the relationship between warehouse automation and safe delivery performance of shipping companies in South-West Nigeria.

## **Research Questions**

The following research questions are developed to address the objectives of the study:

1. What is the relationship between artificial intelligence adoption and on-time delivery of shipping companies in South-West Nigeria?
2. How does artificial intelligence adoption relate to the safe delivery of shipping companies in South-West Nigeria?
3. What is the relationship between transportation technology adoption and on-time delivery of shipping companies in South-West Nigeria?
4. To what extent does transportation technology adoption relate to the safe delivery of shipping companies in South-West Nigeria?
5. What is the relationship between warehouse automation and on-time delivery of shipping companies in South-West Nigeria?
6. How does warehouse automation relate to the safe delivery of shipping companies in South-West Nigeria?



## Research Hypotheses

The following hypotheses were postulated in this study:

HO<sub>1</sub>: There is no significant relationship between artificial intelligence adoption and on-time delivery of shipping companies in South-West Nigeria.

HO<sub>2</sub>: There is no significant relationship between artificial intelligence adoption and the safe delivery of shipping companies in South-West Nigeria.

HO<sub>3</sub>: There is no significant relationship between transportation technology adoption and on-time delivery of shipping companies in South-West Nigeria.

HO<sub>4</sub>: There is no significant relationship between transportation technology adoption and safe delivery of shipping companies in South-West Nigeria.

HO<sub>5</sub>: There is no significant relationship between warehouse automation and on-time delivery of shipping companies in South-West Nigeria.

HO<sub>6</sub>: There is no significant relationship between warehouse automation and the safe delivery of shipping companies in South-West Nigeria.

## REVIEW OF RELATED LITERATURE

### Concept of Logistics Technology

Logistics technology is the application of technology to improve the logistics operations of a firm (Goldsby & Zinn, 2016). Moore (2021) defined logistics technology as the creation of novel scientific methods and procedures that are implemented into practical tools and applications to help adopters and organisations seize significant opportunities in the logistics industry, address issues and mitigate environmental risks. Agus (2008) described logistics technology as the development and use of advanced technology for logistics operations. It involves the creation or application of technology in logistic service delivery (Agus, 2008). Gallino (2018) stated that the replacement of manual logistics operations with technology-driven operations is a significant transformation in the logistics industry. Okwubali et al (2023) opined that the adoption of new logistics technologies is aimed at improving the operational efficiency of the company and generating a competitive advantage in the logistics and supply chain industry. Zhang (2020) stated that logistics technology innovation has a primary goal of improving logistics operations and reducing costs. Bienstock et al. (2018) noted that the application of new logistics technologies gives a company more flexibility, improves service delivery, saves costs and guarantees operational efficiency.

### Dimensions of Logistics Technology

There are several dimensions of logistics technology in literature. However, this study focuses on artificial intelligence, transportation technology and warehouse automation.



## Artificial Intelligence

Before the emergence and application of artificial intelligence in the logistics industry, logistics operations were very complex with about two-thirds of the operations such as picking, packing and shipping being manually driven which brought several challenges including unexpected breakdown, unpredicted weather conditions, static route planning which make it difficult for companies to adapt to real-time changes in traffic or weather conditions, delays in the logistics chain and high operational costs (Fugate et al., 2010). The logistics industry witnessed a significant transition from manual operations to automated operations with the advent of AI. Thongkruer and Wanarat (2021) stated that artificial intelligence has revolutionised logistics operations from warehousing, packaging, and freight to transportation activities. Bienstock et al (2018) noted that AI has transformed logistics operations to the extent that everything is done with streamlined machines and predicted in advance with a high degree of accuracy. By adding AI into logistics processes, companies can track items and vehicles in real time. According to Chapman et al. (2013), companies in the logistics industry can use artificial intelligence to monitor the whereabouts of items and shed light on the handling circumstances. With the use of sensors, temperature and humidity can be monitored and understood. Artificial intelligence can be used to monitor weather and traffic conditions which would enable companies to save travel expenses and time, as well as provide real-time route optimisation recommendations (Okwubali et al., 2023). Artificial intelligence optimises and improves the current operating processes and facilitates effective warehouse planning through big data analysis and machine learning (Nagarajan & White, 2017). Lavastre et al. (2014) explained that artificial intelligence enables companies to handle potential delays through predictive analysis. Lee et al. (2011) noted that AI optimises delivery routes which enables logistics firms to save valuable time and fuel during transit.

## Transportation Technology

Transportation technology is among the recent technological advancements that have transformed the logistics industry. Stank et al. (2017) stated that transport technologies such as telematics have a great impact on the logistics industry as it is used to monitor and control remote devices such as shipment tracking and tracing, vehicle diagnosis and driver hour monitoring. Satellite tracking system is a good example of telematics technology applied in transportation operations. According to Mena et al. (2017), satellite tracking systems can enable operators to position and track vehicles and vessels to assist in real-time planning. This telematics solution which was developed by Marshalls in 2004 was rolled into the fleet of 150 vehicles and it enables logistics companies to monitor the fleet in real-time, improve transportation efficiency by 20% and allow them to be more responsive to changes in the environment. In case anything goes wrong on the road i.e. traffic, vehicle breakdown, or accident, the company will be aware of it within 5 minutes. This quick awareness will enable the company to develop another plan, re-prioritise and reschedule its delivery workload to meet its customers' needs and maintain maximum delivery output (Meng et al., 2017). Radio Frequency Identification (RFID) is another good example of transportation technology. Logistics companies use RFID to track and trace vessels and vehicles during transit (Thongkruer & Wanarat, 2021). This technology has gained wider acceptance in the logistics industry as many logistics firms have embraced it.





## **Warehouse Automation**

Warehouse automation is the process of digitalising warehouse operations by reducing manual labour and making warehousing operations more efficient (Boute & Van Mieghem, 2021). Christian et al. (2021) stated that warehouse automation helps companies save time, reduce costs, and improve the efficiency of their warehouse operations. Viale and Zouari (2020) advised logistics companies to look out for those tasks and processes that can be automated in their warehouse so that they can focus on those tasks that require human involvement. An automated fulfilment solution like ShipBob allows companies to delegate the time-consuming processes of picking, packing, and shipping out orders (Chapman et al., 2013). With this solution, companies can sell on multiple channels, store inventories in fulfilment centres around the world and track their logistics and supply chain performance from one dashboard (Chapman et al., 2013). The Internet of Things (IoT) can help companies automate their warehouse. With IoT sensors, companies can track and synchronise all devices connected to their warehouse management system including drones, autonomous vehicles and smart pallets (Wang et al., 2020). Stavroulaki and Davis (2010) ascertained that tracking helps companies evaluate how long their basic warehousing processes take including the time taken to get orders from the shelf to delivery pick-up station. By using time recording software, companies can track staff attendance, monitor their performance and streamline labour scheduling (Stavroulaki & Davis, 2010). This technology can help a company to minimise overworking, set realistic goals and deadlines, and empower it for effective management of warehouse workers.

## **Concept of Delivery Performance**

Delivery performance means how well a firm can deliver goods to customers at the stipulated time and in the right condition (Shahzadi et al., 2013). It is the result or outcome of the delivery process of a firm. According to Mohamed et al. (2017), delivery performance is the measurement of performance right from the supplier's end to the customer's end. It is a standard criterion in supply chains which is used to measure the fulfilment of a customer's demand (Mohamed et al., 2017). A firm is expected to deliver products in accordance with the specifications and also at the right time (Pelletier et al., 2014). Customers usually value on-time delivery as a symbol of efficient organisation. If a firm is able to deliver a specific product according to the customer's due date, the customer will consider the firm to be reliable and will wish to continue doing business with the firm. This will bring about customer loyalty and retention (Poi & Moko, 2023). Therefore, logistics companies need to improve their delivery performance in order to satisfy and retain their customers and remain competitive in the industry. However, to improve delivery performance, logistics companies need to review their delivery processes and adjust those areas that create room for late delivery. Brabazon and MacCarthy (2017) noted that when a firm reviews its delivery processes, it will have the opportunity to correct the deficiencies and improve its delivery performance. Every company wants to achieve good delivery performance. When a firm delivers the goods to customers on time and in the right condition, such a firm can be said to have a good delivery performance.



## Measures of Delivery Performance

Delivery performance can be measured using various criteria. However, in this study, delivery performance is measured using on-time delivery and safe delivery.

### On-Time Delivery

On-time delivery is the ability of a firm to deliver a specific product at the stipulated time (Shahzadi et al., 2013). Esther and Katuse (2013) defined on-time delivery as the capability of a firm to deliver products to customers in accordance with the agreed or promised date. On-time delivery is crucial for measuring the delivery performance of a logistics firm as it indicates how well the company is meeting its promised delivery time (Kalinzi, 2016). On-time delivery is often used by customers to judge the delivery performance of a company. It is a critical factor that influences customer retention. According to Kemunto and Muturi (2019), customers are happy with logistics companies that increase their delivery speed and as such they are likely to retain the services of such companies in future. Esther and Katuse (2013) reported that today's customers expect 2 days of shipping or less when they place an order. They also revealed that 57% of today's customers would not return to a company after three late deliveries. Linda and Mwaura (2020) argued that the inability of a company to deliver goods at the stipulated time would lead to customer frustration and lack of trust.

### Safe Delivery

Safe delivery is a crucial criterion used to measure the delivery performance of logistics firms as it requires firms to deliver goods in good and perfect condition (Dwayne et al., 2012). Krushinsky et al. (2022) described safe delivery as the delivery of goods in perfect condition without any form of damage. Customers value safe delivery and as such they do not care about any other issue or problem that affects the delivery process. Customers want the company to deliver their products in perfect condition void of any damage. Kemunto and Muturi (2019) noted that customers are happy with logistics companies that deliver their products in a safe manner and as such they are likely to retain their services in future. However, customers are likely to complain when a company deliver products in bad condition with several damages. Brabazon and MacCarthy (2017) opined that when a company delivers products to customers in good and perfect condition, it leads to customer satisfaction and retention. Some logistics companies fail to deliver products in perfect condition. Several factors are responsible for the failure of companies to deliver products in perfect condition. For example, bad roads, poor weather conditions, lack of visibility and higher delivery volumes are some of the factors that are responsible for the damage of goods during transit (Dwayne et al., 2012).

## Theoretical Review

This study adopted the technological determinism theory which was developed by Thorstein Veblen in 2001. The theory states that the emergency of technology and technological changes are the critical factors responsible for the changes in society. This theory explains how the emergence of technology has impacted human thoughts and actions. It has changed the way people do things including the way the logistics operations are carried out. The theory shows how technological emergency drives social, economic, political and organisational change (Green, 2001). It explains the degree to which human thoughts and actions are influenced by technology. However, once a technology is introduced into an organisation's culture, what





follows next is the continuous improvement of that technology. As technology is continuously improved, society embraces the new developments and applies them to solve social problems including those related to logistics operations (Adler, 2006). Technological determinism theory is very useful in explaining the adoption of technology in logistics operations. Obviously, technology has indeed influenced the way logistics service providers think, act and behave. It has influenced all aspects of their operations including transportation, warehousing, picking/sorting, packaging and freight forwarding services. With the advent of technology, logistics service providers can monitor and track their vessels in real time and automate their warehouse operations.

### **Empirical Review**

Some related studies on technology adoption and the performance of firms have been conducted in developing and developed countries. For instance, Kocak (2017) examined the impact of market, entrepreneurial and technology on innovation and firm performance. This study adopted a descriptive survey research design where data were collected from 818 entrepreneurs in Turkey using a structured questionnaire. The data collected were analysed using descriptive statistics while hypotheses were tested using linear regression. The findings revealed that proactive market orientation and technology orientation significantly lead to radical innovation while responsive market orientation significantly affects incremental innovation. The study also revealed that entrepreneurial orientation, directly and indirectly, impacts firm performance via radical and incremental innovation.

Faith and Simon (2023) ascertained the effect of technological innovation, process and product strategies on organisational performance in the telecommunication industry in Kenya. Their study employed the survey research design where a structured questionnaire was used to obtain data from managers in Safaricom Kenya. The data collected were analysed using descriptive statistics while hypotheses were tested using Pearson correlation and regression analysis aided by the SPSS. The findings showed that product innovation has a significant effect on the performance of telecommunication firms in Kenya. The study also processed innovation as a significant effect on the performance of telecommunication firms in Kenya. The study equally found a significant effect of technological innovation on the performance of telecommunication firms in Kenya.

Zhang and Aumeboonsuke (2022) examined the effect of technological innovation and risk-taking on firm performance in China. Their study was conducted among 10 Chinese listed companies using annual data of these companies from 2010 to 2020. The data collected were analysed using regression analysis (E-view) and the findings showed that technological innovation has a significant relationship with firm profitability. The study also revealed that risk-taking has a significant impact on firm profitability. The study concluded that technological innovation and risk-taking have a significant effect on firm performance in China.

Adepoju et al. (2017) explored the impact of technological innovation on SMEs' profitability. Their study adopted the survey research design and used a structured questionnaire to collect data from SME operators in South-West Nigeria. The researchers analysed the data collected using percentage and frequency tables and used the Pearson correlation and regression analysis to test the hypotheses. The findings showed that technological innovation has a positive and



significant relationship with SMEs' profitability. The study concluded that technological innovation has a significant impact on the financial performance of SMEs in Nigeria.

Cui et al. (2010) carried out a study to determine the innovation process of an international third-party logistics firm. Their study employed the in-depth longitudinal case study design and qualitative research approach. Data were collected from senior managers of Dimerco Express Group (DEG) in China and the United States using semi-structured interviews. The data obtained from the interview conducted were analysed using the coding method and the findings showed that the innovation process at Dimerco Express Group (DEG) includes focusing, interacting, analysing, idea generating, justifying, developing, transferring and creating atmosphere. The study also revealed that intra-organizational interactions and inter-organisational interactions play a crucial role in the innovation process in Dimerco Express Group (DEG).

Singhry (2015) empirically examined the supply chain innovation and performance of manufacturing companies. The researcher adopted the cross-sectional survey research design where the questionnaire was used to collect data from 286 manufacturing companies that are members of the Manufacturers Association of Nigeria. The data collected were analysed using descriptive statistics such as percentage and frequency tables while the hypotheses were tested using Confirmatory Factor Analysis (EFA), Structural Equation Modeling (SEM) and regression analysis. The findings showed that supply chain innovation (advanced manufacturing technology, information technology, collaborative processes, top management support, innovation capability) significantly relates to the performance (cost efficiency, customer responsiveness and market performance) of manufacturing companies in Nigeria.

### **Gap in Literature**

The empirical literature reviewed showed that a significant number of studies have been conducted on technology and innovation in the business sector but most of the studies conducted on technology and innovation in the business sector focused on manufacturing, SMEs and telecommunication firms while studies that examined logistics technology adoption and delivery performance of shipping companies in Nigeria are absent or limited. This has created a gap in empirical literature which this study is designed to fill and contribute to the existing literature on logistics technology adoption of firms.

### **METHODOLOGY**

This study is a correlational research that utilises the positivist research philosophy. The study population comprised 65 shipping companies that are functional and duly registered with Nigeria's Shippers Council (NSC) in South-West Nigeria. The shipping companies are spread across the six (6) states in the South-West Geopolitical Zone namely; Ekiti State, Lagos State, Ogun State, Osun State, Oyo State, and Ondo State. A sample size of 20 shipping companies was selected from the population of the study using a purposive sampling technique. The 20 shipping companies were selected purposively based on the premise that they utilise technology such as artificial intelligence, transport technologies (including telematics technology) and warehouse technologies in their logistics operations. However, the units of sampling were made up of managers (logistics managers, transportation managers, warehouse managers, safety managers and operational managers) of the selected shipping companies in



South-West Nigeria. A sampling unit of 100 managers was drawn from the 20 selected shipping companies in South-West Nigeria. A structured questionnaire was used as the main instrument for collecting data from the respondents. The questionnaire was structured on a 4-point rating scale such as Strongly Agree, Agree, Disagree and Strongly Disagree. Face and content analysis was used to test the validity of the instrument while Cronbach Alpha method was used to test the reliability of the instrument. One hundred (100) copies of the questionnaire were administered to the respondents and 82 copies were collected. The data collected were analysed using descriptive statistics while the Pearson Product Moment Correlation Coefficient (PPMCC) was used to test the hypotheses (bivariate analysis). The bivariate analysis was carried out with the aid of the SPSS 24.0 version.

## RESULTS AND DISCUSSION

The data collected on logistics technology adoption and delivery performance were correlated using the SPSS software program version 24. The results of the bivariate analysis are presented in the tables below:

**Table 1: Result of bivariate analysis between artificial intelligence adoption and on-time delivery of shipping companies**

			Artificial Intelligence Adoption	On-Time Delivery
Pearson (r)	Artificial Intelligence Adoption	Correlation Coefficient	1.000	.713**
		Sig. (2 tailed)	.	.001
	Artificial Intelligence Adoption	N	82	82
On-Time Delivery	On-Time Delivery	Correlation Coefficient	.713**	1.000
		Sig. (2 tailed)	.001	.
	On-Time Delivery	N	82	82

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

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

**Source:** SPSS-Generated Output

Table 1 presents the result of the bivariate analysis carried out between artificial intelligence adoption and on-time delivery of shipping companies in South-West Nigeria. The result shows that artificial intelligence adoption is strongly and positively correlated to on-time delivery of shipping companies ( $r = .713^{**}$ ) and the symbol \*\* indicates that this correlation is significant at 0.01 level. Hence, the null hypothesis ( $H_{01}$ ) is rejected and the alternate hypothesis is accepted. This means that we then accept that there is a significant relationship between artificial intelligence adoption and on-time delivery of shipping companies in South-West Nigeria.



**Table 2: Result of bivariate analysis between artificial intelligence adoption and safe delivery of shipping companies**

			Artificial Intelligence Adoption	Safe Delivery
Pearson (r)	Artificial Intelligence Adoption	Correlation Coefficient	1.000	.639**
		Sig. (2 tailed)	.	.001
		N	82	82
	Safe Delivery	Correlation Coefficient	.639**	1.000
		Sig. (2 tailed)	.001	.
		N	82	82

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

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

**Source:** SPSS-Generated Output

Table 2 shows the result of the bivariate analysis carried out between artificial intelligence adoption and safe delivery of shipping companies in South-West Nigeria. The result indicates that artificial intelligence adoption has a strong positive correlation with safe delivery of shipping companies ( $r = .639^{**}$ ) and this correlation is significant at 0.01 level as signified by the symbol \*\*. Consequently, the null hypothesis ( $H_{02}$ ) is rejected and the alternate hypothesis is accepted. This means that we then accept that there is a significant relationship between artificial intelligence adoption and the safe delivery of shipping companies in South-West Nigeria.

**Table 3: Result of bivariate analysis between transportation technology adoption and on-time delivery of shipping companies**

			Transportation Technology Adoption	On-Time Delivery
Pearson (r)	Transportation Technology Adoption	Correlation Coefficient	1.000	.814**
		Sig. (2 tailed)	.	.001
		N	82	82
	On-Time Delivery	Correlation Coefficient	.814**	1.000
		Sig. (2 tailed)	.001	.
		N	82	82

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

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

**Source:** SPSS-Generated Output

Table 3 depicts the result of the bivariate analysis carried out between transportation technology adoption and on-time delivery of shipping companies in South-West Nigeria. The result shows a strong and positive correlation between transportation technology adoption and on-time delivery of shipping companies ( $r = .814^{**}$ ) and the symbol \*\* indicates that this correlation is significant at 0.01 level. Based on this result, we reject the null hypothesis ( $H_{03}$ ) and accept the alternate hypothesis which states that there is a significant relationship between transportation technology adoption and on-time delivery of shipping companies in South-West Nigeria.



**Table 4: Result of bivariate analysis between transportation technology adoption and safe delivery of shipping companies**

		Transportation Technology Adoption	Safe Delivery
Pearson (r)	Transportation Technology Adoption	Correlation Coefficient	1.000
		Sig. (2 tailed)	.001
		N	82
	Safe Delivery	Correlation Coefficient	.847**
		Sig. (2 tailed)	.001
		N	82

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

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

**Source:** SPSS-Generated Output

Table 4 presents the result of the bivariate analysis carried out between transportation technology adoption and safe delivery of shipping companies in South-West Nigeria. The result shows that transportation technology adoption has a strong and positive correlation with safe delivery of shipping companies ( $r = .847^{**}$ ) and this correlation is significant at 0.01 level as indicated by the symbol \*\*. Hence, the null hypothesis ( $H_{04}$ ) is rejected and the alternate hypothesis is accepted. This implies that we then accept that there is a significant relationship between transportation technology adoption and the safe delivery of shipping companies in South-West Nigeria.

**Table 5: Result of bivariate analysis between warehouse automation and on-time delivery of shipping companies**

		Warehouse Automation	On-Time Delivery
Pearson (r)	Warehouse Automation	Correlation Coefficient	1.000
		Sig. (2 tailed)	.001
		N	82
	On-Time Delivery	Correlation Coefficient	.655**
		Sig. (2 tailed)	.001
		N	82

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

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

**Source:** SPSS-Generated Output

Table 5 shows the result of the bivariate analysis carried out between warehouse automation and on-time delivery of shipping companies in South-West Nigeria. The result indicates a strong and positive correlation between warehouse automation and on-time delivery of shipping companies ( $r = .655^{**}$ ) and the symbol \*\* signifies that this correlation is significant at 0.01 level. Based on this result, we then reject the null hypothesis ( $H_{05}$ ) and accept the alternate hypothesis which states that there is a significant relationship between warehouse automation and on-time delivery of shipping companies in South-West Nigeria.





**Table 6: Result of bivariate analysis between warehouse automation and safe delivery of shipping companies**

			Warehouse Automation	Safe Delivery
Pearson (r)	Warehouse Automation	Correlation Coefficient	1.000	.673**
		Sig. (2 tailed)	.	.001
		N	82	82
	Safe Delivery	Correlation Coefficient	.673**	1.000
		Sig. (2 tailed)	.001	.
		N	82	82

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

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

**Source:** SPSS-Generated Output

Table 6 presents the result of the bivariate analysis carried out between warehouse automation and safe delivery of shipping companies in South-West Nigeria. The result shows that warehouse automation has a strong and positive correlation with safe delivery of shipping companies ( $r = .673^{**}$ ) and this correlation is significant at 0.01 level as indicated by the symbol \*\*. Consequently, the null hypothesis ( $H_{06}$ ) is rejected and the alternate hypothesis is accepted. This implies that we then accept that there is a significant relationship between warehouse automation and the safe delivery of shipping companies in South-West Nigeria.

## DISCUSSION OF FINDINGS

This study discovered a significant relationship between artificial intelligence adoption and on-time delivery of shipping companies in South-West Nigeria. This finding was derived from the result of the statistical analysis carried out on the two variables in the first hypothesis. The result revealed that artificial intelligence adoption is strongly and positively correlated to on-time delivery of shipping companies ( $r = .713^{**}$ ) and this correlation is significant at 0.01 level. Hence, the null hypothesis ( $H_{01}$ ) was rejected and the alternate hypothesis was accepted. This means that we then accepted that there is a significant relationship between artificial intelligence adoption and on-time delivery of shipping companies in South-West Nigeria. This finding is consistent with the research conducted by Sipos & Bizoi (2015) and Goldsby & Zinn (2016) as both studies revealed that artificial intelligence significantly improves the delivery performance of firms.

This study also discovered a significant relationship between artificial intelligence adoption and the safe delivery of shipping companies in South-West Nigeria. This finding was deduced from the result of the statistical analysis carried out on the two variables in the second hypothesis. The result showed that artificial intelligence adoption has a strong positive correlation with the safe delivery of shipping companies ( $r = .639^{**}$ ) and this correlation is significant at 0.01 level. Consequently, the null hypothesis ( $H_{02}$ ) was rejected and the alternate hypothesis was accepted. This means that we then accepted that there is a significant relationship between artificial intelligence adoption and the safe delivery of shipping companies in South-West Nigeria. This finding is supported by Moore (2021) who noted that artificial intelligence adoption would enable logistics firms to deliver products safely. Tapscott



and Tapscott (2017) also supported this finding when they revealed that logistics companies are likely to deliver products in a safe manner if they adopt artificial intelligence in their logistics operations.

This study found a significant relationship between transportation technology adoption and on-time delivery of shipping companies in South-West Nigeria. This finding emerged from the result of the statistical analysis carried out on the two variables in the third hypothesis. The result showed a strong and positive correlation between transportation technology adoption and on-time delivery of shipping companies ( $r = .814^{**}$ ) and this correlation is significant at 0.01 level. Based on this result, we then rejected the null hypothesis ( $H_{03}$ ) and accepted the alternate hypothesis which states that there is a significant relationship between transportation technology adoption and on-time delivery of shipping companies in South-West Nigeria. This finding is consistent with the research conducted by Blecker et al. (2014) which reported that logistics companies that adopt transportation technology would deliver their products promptly. Bienstock et al. (2018) also agreed with this finding as they revealed that the application of transportation technology would enable logistics firms to track their vessels, solve problems and deliver goods to their destination on the scheduled date.

A significant relationship was also reported between transportation technology adoption and safe delivery of shipping companies in South-West Nigeria. This finding was obtained from the result of the statistical analysis carried out on the two variables in the fourth hypothesis. The result revealed that transportation technology adoption has a strong and positive correlation with the safe delivery of shipping companies ( $r = .847^{**}$ ) and this correlation is significant at 0.01 level. Hence, the null hypothesis ( $H_{04}$ ) was rejected and the alternate hypothesis was accepted. This implies that we then accepted that there is a significant relationship between transportation technology adoption and the safe delivery of shipping companies in South-West Nigeria. Tapscott and Tapscott (2017) agreed with this finding when they revealed that the application of transportation technology would improve the delivery performance of firms. Moore (2021) also supported this finding when she revealed that logistics companies would deliver goods in a safe manner if they adopted modern technologies in their transportation operations.

This study equally revealed that warehouse automation has a significant relationship with on-time delivery of shipping companies in South-West Nigeria. This finding emerged from the result of the statistical analysis carried out on the two variables in the fifth hypothesis. The result showed a strong and positive correlation between warehouse automation and on-time delivery of shipping companies ( $r = .655^{**}$ ) and this correlation is significant at 0.01 level. Based on this result, we then rejected the null hypothesis ( $H_{05}$ ) and accepted the alternate hypothesis which states that there is a significant relationship between warehouse automation and on-time delivery of shipping companies in South-West Nigeria. Goldsby and Zinn (2016) agreed with this finding when they revealed that warehouse automation would ensure the timely delivery performance of firms. Bienstock et al. (2018) also supported this finding when they revealed that logistics companies would deliver goods timely if they adopted modern technologies in their warehouse operations.



Finally, it was discovered that warehousing automation has a significant relationship with the safe delivery of shipping companies in South-West Nigeria. This finding was derived from the result of the statistical analysis carried out on the two variables in the sixth hypothesis. The result revealed that warehouse automation has a strong and positive correlation with the safe delivery of shipping companies ( $r = .673^{**}$ ) and this correlation is significant at 0.01 level. Consequently, the null hypothesis ( $H_{06}$ ) was rejected and the alternate hypothesis was accepted. This implies that we then accepted that there is a significant relationship between warehouse automation and the safe delivery of shipping companies in South-West Nigeria. This finding is supported by Nagarajan and White (2017) who noted that warehouse automation would facilitate effective tracking of items and ensure a safe movement of products to customers. Sipos and Bizoi (2015) also supported this finding when they revealed that logistics companies are likely to deliver products in a safe manner if they adopt modern technologies in their warehouse operations.

## CONCLUSIONS

Given the dynamic nature of the business environment and the intense competition in the logistics industry, it becomes necessary for shipping companies to adopt modern technology in their logistics operations in order to improve their delivery performance. This can be done by applying artificial intelligence and transportation technology as well as automating their warehouse operations. The results of this study have proven that the adoption of artificial intelligence, transportation technology and warehouse automation has a positive and significant relationship with the delivery performance of shipping companies in South-West Nigeria. The implication of this finding is that if shipping companies adopt artificial intelligence and transportation technology and automate their warehouse operation, they will deliver their products in a safe and timely manner, and hence improve their delivery performance.

## RECOMMENDATIONS

The following recommendations are provided based on the findings:

1. Nigeria Shipping companies should switch from their manual operations to technology-driven operations as it would enhance the delivery performance.
2. Nigeria Shipping companies should utilise modern technology in their transportation and warehousing operations as it would ensure a safe and timely delivery of goods to their customers.
3. Nigeria Shipping companies should apply artificial intelligence in their logistics operations as it would enable them to track items and vehicles in real-time, make predictions in advance with a high degree of accuracy and ensure a safe delivery of products to their destination.
4. Nigeria Shipping companies should adopt technology such as telematics, satellite tracking systems and radio frequency identification (RFID) in their transportation



operations as it would enable them to monitor and control remote devices, track and trace vessels during shipment, monitor traffic or weather conditions, diagnose vessels, monitor driver hour (speed) and achieve safe delivery of cargo.

5. Finally, it is recommended that Nigerian shipping companies should utilise modern technology in their warehousing operations such as picking and packing as this would enable them to avoid delays reduce their operational costs and improve their delivery performance.

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