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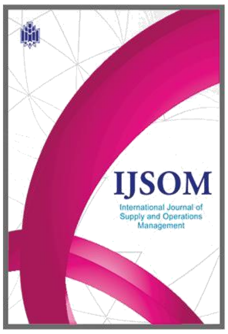

Influence of Information Flow on Logistics Management in the Industry 4.0 Era

Dennis Ayodeji Adeitan[a*], Clinton Aigbavboa[b], Olufemi Sylvester Bamisaye[c]

[a*] Postgraduate School of Operations Management, University of Johannesburg, Johannesburg, South Africa
[b] Department of Construction Management and Quantity Surveying, University of Johannesburg, Johannesburg, South Africa
[c] Mechanical Engineering Department, Air Force Institute of Technology, Kaduna, Nigeria

Abstract

Industry 4.0 technologies have capacities to improve competitiveness in the logistics chain by taking advantage of information flow through the logistics processes. This paper aims to determine the influence of effective and new information flow on logistics management in Nigeria. The methodology used in this study includes; the quantitative methodology, a mean item score, exploratory factor analysis, normality test, and Man-Whitney test. Findings revealed negotiating better contracts, better product tracking, better quality logistics information flow, expanded network, and enhanced information transfer as the top five effect of information flow on logistics management in Nigeria. It is recommended that Nigerian companies engaging in logistics activities need to adopt industry 4.0 technologies to aid effective and new information flow in their logistics management processes. Finally, the growth of logistics firm and its ability to compete depend on effective information flow.

Keywords: Logistics information flow; Logistics management; Information transfer; Quantitative method; Industry 4.0.

1. Introduction

Supply chain logistics comprises of the coordination of material and information flow across the supply chain (Harrison and Van Hoek, 2008). Information and data management, an essential intermediary in the industry 4.0 era, uses cloud sources to gather and evaluate data in an efficient way (Adeitan et al., 2019). Proper information flow throughout the supply chain processes enhance quality products at a low cost, increased productivity, and competitiveness in the manufacturing companies. The effectiveness in the physical flow of product distribution for competitiveness in the supply and logistics chain sector is felt essential. In this period of globalization, there is a rise in the international competitiveness of supply chains and increased logistics flow complexity that contributes to a great demand for custom-made products.

Dimitrov (2005) mentioned that logistics chain networks are becoming more complex and more extended; therefore, adequate information flow must strengthen the logistics decision-making method's effectiveness. The arrival of Industry 4.0 in production, supply, and logistics chain reduces the complexity and challenges experienced in the supply chain and develops the interconnected systems. The usefulness of Industry 4.0 is to connect all conditions in the supply chain, such as vital information in real-time, people, systems, and data of value-added information flow. Furthermore, the essence of the information system in logistics management is collecting information, storing the information, processing and delivering the information, and establishing an optimal decision that organizes the logistics activities. According to Voortman (2004), information flow and computerized technologies are essential to a firm's growth, keen to know and achieve customers' requirements and needs. This is because of the nature of global logistics and supply chain that requires

* Corresponding author email address: adeitandennis@gmail.com
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effective information systems to boost inventory control, track materials and orders, monitor resource use, optimize logistics cost, and improve customer service. The collected information will require computerized technologies and a practical approach to connecting the industrial and logistics value chain.

Logistics processes and activities are linked with materials flows, logistics information systems, and raw materials. It integrates many information sources: purchasing information, transport, warehousing information, delivery information, payment information schedule, manufacturing information schedule, information of an order, and packaging information schedule (Voortman, 2004). In summary, logistics information flow establishes a definite system that shows the structure of interconnected people, equipment, and methods, enabling logisticians to retrieve and process information for scheduling, executing, and controlling. A study conducted by Loos and Allweyer (1998) proposed that an adequate flow of information is essential for feedback routes among logistics and firms throughout the planning and implementation stages of business organizations. Therefore, this work aims to explore practical and new information flow on logistics management in Nigerian firms. The significant contribution of this paper is to provide some needed clarity about the influence of new information flow on logistics management. The paper's other contribution is to help Nigerian logistics companies to determine the most important effect of new information flow to their logistics chain processes in the era of Industry 4.0.

In other to accomplish this, section 2 briefly reviews the existing body of knowledge on the concept of Industry 4.0 and logistics processes. Section 2 also highlights information flow in logistics management. Section 3 displays the method used to conduct the research. Section 4 shows the results of research on the influence of effective and new information flow on logistics management in Nigeria. The discussion of results and implications are shown in Section 5. Finally, section 6 concludes the study with recommendations and suggestions for future research directions.

2. Literature Review

2.1. Industry 4.0 in Logistics

Industry 4.0 is an advanced digitalization inside manufacturing industries, which involves a combination of internet tools with cutting-edge technologies in machines and products (Lasi et al., 2014). Industry 4.0 tools have made it easier for firms to team up and share information between customers, manufacturers, contractors, and other parties in the logistics chain. These have helped companies to customize products according to the needs of an individual customer (Yua, 2020). According to Yao (2018), Industry 4.0 involves information transformation of production in a linked environment of processes, data, systems, services, people, and executable information as a technique to represent the smart factory and innovative manufacturing environments. This allows and converts manufacturing systems in a way that the products regulate their distinct manufacturing method. The development of technologies and operational changes in the worldwide economy has helped supply and logistics companies to reassess their value-added chain and assign additional resources to their information system. In the field of logistics, the variety of products that the chain can handle, the new methods and technologies introduced in production and service, the several logistics operations systems, and the need for globalization have made it essential to increase the efficient flow of information for the effective logistic decision-making process (Skapinyecz, 2018).

The major challenge of logistics is improving the flow in the manufacturing system, distribution, and organizing all flows in the manufacturing sector. According to Skapinyecz (2018), the solution is adopting automated and enhanced intricate structures, processes, and sub-processes. These automated structures and processes will establish coordination, and fast track logistics flows such as; radio frequency identification and efficient consumer response (Bahija, 2016). The arrival and application of Industrial 4.0 tools in the logistics methods lead to more critical changes in the operation of the economy (Skapinyecz, 2018). This is because logistics is based on a human-machine-based system that includes; information technology systems and networks, machine systems, machines material handling systems, the method, technology, and human skill. Supply management 4.0 is a vital conceptual component of Industry 4.0 as it links the several supply chain, allowing an active, quick collaboration and coordination of logistics boundaries. Also, when logistics management is highlighted in Industry 4.0, it shows the intelligent systems and effective movement in all the diverse aspects starting in smart warehousing and smart supply chain to an automated guided vehicle and then auto-store system the information connection inside all logistics surroundings. Hence, informatics, digitalization, and information technology in logistics have transformed the market expectations and logistics prospects. Winkelhaus and Grosse (2019) mentioned that the key impact of Logistics 4.0 is information sharing to enable visibility and reduce uncertainties in the logistics chain. These are necessary for tracking, forecasting, planning and controlling spatially, and temporally distributed intricate systems. Also, it supports most logistics activities either directly or indirectly.

For Industry 4.0 to be more efficient, information must be accessible in the entire company and the supply chain. New data management technologies and intelligent manufacturing systems can separately analyze the logistics chain performance and suggest continuous development plans for success (Alavian et al., 2020). According to Yua (2020), the fast growth of Industry 4.0 tools has helped inventory systems to be fully transformed into a new state. Logistics chains are completely visible, linked, digitized, and integrated. Digitalization entirely transforms the part of production and services so that logistics activities' operational parameters have become open. At the same time, in the industry 4.0 setting, the safeguarding of data sets' organization leads to the strengthening of the customer-controlled activities in logistics services.

In investigating Industry 4.0 on logistics management, intra-corporate, and non-corporate logistics methods must be studied. Intra-corporate logistics processes arrangement, design, and procedures are greatly influenced by the accomplishments of Industry 4.0, helping firms to track and trace user needs and procurement orders in real-time. According to Nagy et al. (2018), the gathering and analyzing quality information in suitable quantities involves a high level of information technology and computerization. Industry 4.0 tools can offer a practical solution to this problem and boost supply chain networks' effectiveness. The companies' performance and competitiveness performing logistics operations can be improved by digitalization, automation, and growth of logistics methods based on Industry 4.0 technology. Owing to Industry 4.0 tools, logistics companies can now design their capacities and resources to prepare to receive and store the products meant for delivery. Industry 4.0 technologies can help in attaining performance improvements such as reduced cost, improved product quality, greater flexibility, and better partnership with environmental sustainability and safety of employees (Chiarini et al., 2020). Also, benefits of Industry 4.0 technology to businesses are; increased productivity, enhanced manufacturing processes, faster technology development, and improved customer service (Huber et al., 2019; Yua, 2020).

2.2. Information Flow in Logistics Management

Information flow is an efficient movement of information originating from a source towards the endpoint (De Wolf and Holvoet, 2007). The flow of information can pass through numerous points that can lead to an accumulation of new information joined into the information flow. According to Henczel (2001), information flow within an organization involves information sharing amongst people in an organization, various departments in an organization, and its environment. Information flow in an organization must be timely and suitable from a transmitter at the starting point to a receiver at the finish point. Another definition of information flow by Durugbo et al. (2014) says that information flow is the access, sharing, and documentation of information with people, and hence information sharing is also a vital aspect of information flow. Some of the different information flows amongst firms in a supply and logistics chain include; order status, inventory levels, sales information, sales forecasts, production lists, and delivery schedules (Lee and Whang, 2000). Another study by Knolmayer et al. (2002) also mentioned that information sharing in supply chains comprises; sales orders, sales forecasts, inventory levels, and resource types.

The addition of new and effective information to the supply chain can be found in information sharing about the production process, shipment records, delivery, inventory level, production volume, sales and performance in companies, and among supply chain members (Patnayakuni and Rai, 2002). Also, supply chain and logistics companies can gain competitiveness and performance from joining new and effective information flows across the supply chain, improving production capacity, and flow from a supply chain perspective. Logistics information system integration in logistics chains increases the logistics methods' capacities and accuracy in improving both lead time and inventory from suppliers' locations to the final users (Lai et al., 2005; Mourtzis, 2011). As described by Nowakowska-Grunt and Nowakowska (2012), the information provided within a firm must meet some criteria, which control their usefulness in decision-making. These criteria include; adequacy of information, the accuracy of the information, reliability of the information, and types of decision rules present to the receivers. Presently, many logistics information systems and technologies have been established to assist companies in attaining improved information flow. Some of the information systems are; database management systems (DBMS), Materials Requirement Planning (MRP), Enterprise Resources Planning (ERP), Customer Relationship Management (CRM), Vendor Managed Inventory (VMI), Component Supplier Management (CSM), and Quick Response (QR) (Wamba and Boeck, 2008). These adopted technologies assist in inter-organizational information sharing at several phases of the supply/logistics chain and boost performance via business process optimization.

Wong and Karia (2010) mentioned that information resources could be most significant for third party logistics outsourcing because they can access up to date information from the logistics chains. Industry 4.0 can improve logistics by taking advantage of information flow through the logistics processes. Industry 4.0 applications in logistics processes include; inventory monitoring, decreased equipment errors, reduced product delivery time, accurate tracking of delivery trucks and commercial vehicles, and freight quality damage reduction. The benefits of information flow to logistics and supply chain management include an increase in safety of stock, inventory reduction, decrease in cost, reduction of uncertainties, enhanced resource utilization, improved tracing and tracking, organizational efficiency, earlier time to market, reduction in cycle time from order to delivery, expanded network, negotiate better contracts, find less expensive transportation modes, efficient and precise reporting, and a better understanding of the various types of cost to serve customers (Lee and Whang, 2000; Fiala 2005, Lotfi, 2013). Azevedo et al. (2007) reiterate that the start of information technology in logistics provides connections within the business and its activity with the customers, suppliers, and the distribution method. Hence, software, hardware, and technology transfer in logistics information must be adapted to enhance the communication and serve the logistics system systematically. The information flow must not be directed to suppliers alone and on the customers' ability to source and determine what they need or require in a shorter ordering time.

New effective information flow enables firms to make better planning decisions in their operations, such as improved resource utilization, supply and logistics chain costs minimization, and better responsiveness to customers' needs (Lee et al., 2000; Mentzer, 2004). Furthermore, logistics information systems enable better logistics decision making, more accurate costing, enhanced information transfer between buyers and sellers, better quality logistics information flow, smooth flow of material and products, smooth information flow to all logistics functions, and better quantity logistics information flow (Voortman, 2004). A study by Cheng and Wu (2005) reveals that the level of inventory and expected cost are inversely proportional to the influence of information sharing on inventory and cost in a two-echelon supply chain. McLaren et al. (2004) investigated in their study that organizational capabilities, organizational performance, and organizational efficiency are part of other advantages of information sharing. Fitzpatrick and Ali (2010) mention that information flow in different logistics activities can reduce costs and improve the efficiency of the manufacturing system. Mourtzis (2011) stated that information flow among different parties inside a logistics network can improve productivity, better operational efficiency, improve resource utilization, influence business partnerships, and improvement in business connections.

According to Jagersma (2011), the five most vital driving forces for information logistics are; cost reduction opportunities due to the efficient and effective use of information, improved quality in decision making, innovation and ingenuity, improved customer order and business understanding, improvement in management processes, and better customer relations. Useful information in logistics is a complex task; it frequently involves fluctuations in internal organization and working relationships, information and control structures have to be modified, and frequently, responsibilities must be moved inside the company (Jagersma, 2011). As reported by Filipe et al. (2007), some vital concepts for implementing information logistics are; finding appropriate content for information demand, capturing and modeling information demand, fast delivery of relevant content for the device, and communication channel accessible to the user. A logistics information system connects the logistics activities and integrates information sources such as payment information, delivery information, production information schedule, the packaging information schedule, and order information (Voortman, 2004). Furthermore, the logistics information system includes components that allow the processes to be performed efficiently and provide data to simplify planning and coordination.

3. Methodology

A random sampling technique was utilized for choosing respondents from the sample frame, within the study population that consists of professionals and employees of logistics management departments of the selected logistics companies. The seventeen (17) factors which were identified in the questionnaire to understand the response of the industry on the influence of information flow on logistics management were selected based on a review of the literature used for this study.

A total of 106 questionnaires were duly completed out of the one hundred and fifty (150) administered to the different respondents. Respondents were requested to specify the level of the adequate and new information flow on logistics management in Nigeria based on a five-point Likert scale (strongly agree = 5, agree = 4, neutral, = 3, disagree = 2, strongly disagree = 1). The response rate for the questionnaires administered was seventy-one percent (71%).

The respondent's demographics revealed that the majority of the respondents in this survey were of the age range; 26-30 years (59.4 %) to 31-35 years (23.6 %) and had a work experience of 0-5 years (69.8%) and 6-10 years (21.7 %) in the logistics industry. Statistical data analysis was done using SPSS analysis software. The analyzed data was generated from the administered questionnaires. The mean item score and factor analysis were the two statistical analyses carried out on the variables. The mean item score was employed in finding the importance of the variables, while the exploratory factor analysis was conducted to gather information about the uni-dimensionality of the factors.

4. Influence of Effective and New Information Flow on Logistics Management in Nigeria

The mean item score was employed in finding the importance of the variables. The mean item result reveals the ranking of each factor from the highest to the lowest, as shown in Table 1. It assesses the influence of adequate and new information flow on logistics management in Nigeria. The result also reveals a standard deviation of each factor. All the itemized factors have mean values greater than 2.5, signifying that the respondents agree that they influence significant and new information flow on logistics management in Nigeria.

The results in Table 1 revealed that negotiating better contracts was ranked first with a mean item score of 3.99 and standard deviation of 1.009; better product tracking and forecasting reports was ranked second with a mean score of 3.98 and standard deviation of 1.042; better quality logistics information flow was ranked third with a mean score of 3.97 and standard deviation of 1.009; expanded network was ranked fourth with a mean score of 3.96 and standard deviation of 1.050; enhanced information transfer between buyers/sellers and it helps in timely delivery were both ranked fifth with a mean score of 3.93 and standard deviations of 1.017 and 1.089; more accurate costing and reduced lead time were both ranked sixth with a mean score of 3.92 and standard deviations of 0.902 and 1.048; smooth flow of material and products was ranked seventh with a mean score of 3.91 and standard deviation of 1.083; better operational efficiency was ranked eighth with a mean score of 3.90 and standard deviation of 1.077; increase in safety of goods and smooth information flow to all logistics functions were both ranked ninth with a mean score of 3.87 and standard deviation of 1.024 and 1.043; reduction of uncertainties was ranked tenth with a mean score of 3.83 and standard deviation of 1.064; better quantity logistics information flow was ranked eleventh with a mean score of 3.82 and standard deviation of 1.012; and providing less expensive transportation nodes was ranked twelfth with a mean score of 3.79 and standard deviation of 1.039. Finally, reduced inventory level and decrease in cost were ranked thirteenth with a mean score of 3.58 and standard deviations of 1.077 and 1.178.

Table 1. Influence of Effective and New Information Flow on Logistics Management in Nigeria

S/N	**Information Flow in Logistics Management**	**Mean ($\bar{x}$)**	**Standard deviation (σX)**	**Rank (R)**
1	Negotiating Better Contracts	3.99	1.009	1
2	Better Product Tracking and Forecasting Reports	3.98	1.042	2
3	Better Quality Logistics Information Flow	3.97	1.009	3
4	Expanded Network	3.96	1.050	4
5	Enhanced Information Transfer between Buyers and Sellers	3.93	1.017	5
6	It helps in Timely Delivery	3.93	1.089	5
7	More Accurate Costing	3.92	0.902	6
8	Reduced Lead Time	3.92	1.048	6
9	Smooth flow of material and products	3.91	1.083	7
10	Better Operational Efficiency	3.90	1.077	8
11	Increase in Safety of Goods	3.87	1.024	9
12	Smooth Information Flow to all Logistics Functions	3.87	1.043	9
13	Reduction of Uncertainties	3.83	1.064	10
14	Better quantity Logistics Information Flow	3.82	1.012	11
15	Providing Less Expensive Transportation Nodes	3.79	1.039	12
16	Reduced Inventory Level	3.58	1.077	13
17	Decrease in Cost	3.58	1.178	13

4.1 Exploratory Factor Analysis

Exploratory factor analysis was performed using the Statistical Package Software for Social Sciences (version 21.0). It was employed to determine which variables could be the measuring parts of the same underlying dimensions. Exploratory factor analysis was used to categorize groups of related variables, assemble information and data about the interrelationship among a set of variables, and decrease a large number of variables into a more understood framework (Pallant, 2007). Out of the seventeen variables listed for the first approach, none was omitted. The correlation matrix's factorability can be determined if it can show some correlations of $r = 0.3$. Before performing the principal components analysis, the fitness of the data for factor analysis was first evaluated, and the correlation matrix shows values above 0.3, as shown in Figure 1.

Bartlett's test of sphericity should be statistically significant or measured at $p < 0.05$, and the Kaiser-Meyer-Olkin (KMO), which measures the sampling suitability value, must be 0.6 or above. In Table 2, Bartlett's test of sphericity was also statistically significant at $P = 0.000$ with a value of 1642.616. These suggest that the population matrix was not an identity matrix; it supports the correlation matrix's factorability. Also, the Kaiser-Meyer–Olkin measure of sampling acceptability attained a value of 0.943, thus exceeding the proposed minimum value of 0.6, which specifies that sufficient items for each factor or sample size were favorable for the factor analysis to proceed. The data were subjected to principal components analysis using varimax rotation. As seen in Table 3, the rotated factor matrix was based on a traditional high value of 1 with one factor. As shown in Table 4, the final statistics of the principal components analysis and the extracted factor accounted for about 65% of the entire cumulative variance. The Cronbach's alpha values for the empirical reliability are 0.967, which suggested that the reliability of the instrument used for the study was good.

Correlation	F12.1	F12.2	F12.3	F12.4	F12.5	F12.6	F12.7	F12.8	F12.9	F12.10	F12.11	F12.12	F12.13	F12.14	F12.15	F12.16	F12.17
F12.1	**1.000**	0.709	0.554	0.559	0.592	0.475	0.414	0.564	0.445	0.582	0.678	0.546	0.445	0.478	0.529	0.544	0.624
F12.2	0.709	**1.000**	0.545	0.724	0.638	0.626	0.575	0.628	0.621	0.567	0.658	0.600	0.533	0.637	0.612	0.632	0.660
F12.3	0.554	0.545	**1.000**	0.594	0.665	0.553	0.647	0.626	0.601	0.663	0.536	0.649	0.603	0.549	0.620	0.545	0.626
F12.4	0.559	0.724	0.594	**1.000**	0.713	0.679	0.574	0.583	0.682	0.557	0.626	0.641	0.678	0.667	0.643	0.630	0.631
F12.5	0.592	0.638	0.665	0.713	**1.000**	0.656	0.615	0.630	0.688	0.553	0.632	0.703	0.590	0.664	0.654	0.618	0.594
F12.6	0.475	0.626	0.553	0.679	0.656	**1.000**	0.644	0.722	0.715	0.621	0.607	0.640	0.719	0.727	0.742	0.655	0.645
F12.7	0.414	0.575	0.647	0.574	0.615	0.644	**1.000**	0.741	0.710	0.632	0.568	0.585	0.594	0.656	0.615	0.557	0.596
F12.8	0.564	0.628	0.626	0.583	0.630	0.722	0.741	**1.000**	0.673	0.673	0.650	0.633	0.565	0.693	0.801	0.717	0.697
F12.9	0.445	0.621	0.601	0.682	0.688	0.715	0.710	0.673	**1.000**	0.652	0.627	0.625	0.681	0.668	0.731	0.696	0.658
F12.10	0.582	0.567	0.663	0.557	0.553	0.621	0.632	0.673	0.652	**1.000**	0.654	0.591	0.588	0.591	0.643	0.572	0.652
F12.11	0.678	0.658	0.536	0.626	0.632	0.607	0.568	0.650	0.627	0.654	**1.000**	0.659	0.582	0.618	0.636	0.648	0.664
F12.12	0.546	0.600	0.649	0.641	0.703	0.640	0.585	0.633	0.625	0.591	0.659	**1.000**	0.757	0.705	0.676	0.652	0.752
F12.13	0.445	0.533	0.603	0.678	0.590	0.719	0.594	0.565	0.681	0.588	0.582	0.757	**1.000**	0.658	0.689	0.640	0.697
F12.14	0.478	0.637	0.549	0.667	0.664	0.727	0.656	0.693	0.668	0.591	0.618	0.705	0.658	**1.000**	0.773	0.648	0.684
F12.15	0.529	0.612	0.620	0.643	0.654	0.742	0.615	0.801	0.731	0.643	0.636	0.676	0.689	0.773	**1.000**	0.782	0.738
F12.16	0.544	0.632	0.545	0.630	0.618	0.655	0.557	0.717	0.696	0.572	0.648	0.652	0.640	0.648	0.782	**1.000**	0.806
F12.17	0.624	0.660	0.626	0.631	0.594	0.645	0.596	0.697	0.658	0.652	0.664	0.752	0.697	0.684	0.738	0.806	**1.000**

Figure 1. Correlation Matrix of Factor Analysis

Table 2. Kaiser-Meyer–Olkin and Bartlett's test

Kaiser-Meyer-Measure of Sampling Adequacy.		.943
Bartlett's Test of Sphericity	Approx. Chi-Square	1642.616
	df	136
	Sig.	.000

Table 3. Rotated Factor Matrix

	Factor
	1
Smooth flow of material and products	0.860
It helps in timely delivery	0.844
Expanded network	0.834
Negotiating better contracts	0.825
Better product tracking and forecasting reports	0.821
Enhanced information transfer between buyers and sellers	0.821
Increase in the safety of goods	0.819
Smooth information flow to all logistics functions	0.815
Better quantity logistics information flow	0.800
Better quality logistics information flow	0.798
Reduction of uncertainties	0.787
More accurate costing	0.785
Better operational efficiency	0.779
Providing less expensive transportation nodes	0.765
Reduced lead time	0.762
Reduced inventory level	0.747
Decrease in cost	0.678
Extraction Method: Principal Axis Factoring. 1 factor extracted	

Table 4. Total Variance Explained

Factors	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotated Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**11.171**	65.711	**65.711**	10.813	63.607	63.607	10.813	63.607	**63.607**
2	0.891	5.240	70.951						
3	0.675	3.971	74.922						
4	0.633	3.721	78.643						
5	0.579	3.407	82.050						
6	0.435	2.561	84.611						
7	0.397	2.337	86.948						
8	0.363	2.137	89.085						
9	0.352	2.069	91.155						
10	0.283	1.665	92.820						
11	0.242	1.425	94.245						
12	0.215	1.265	95.510						
13	0.197	1.160	96.670						
14	0.187	1.102	97.772						
15	0.154	0.907	98.679						
16	0.122	0.717	99.396						
17	0.103	0.604	100.000						
Extraction Method: Principal Axis Factoring									

4.2. Normality Test

The data obtained from the study were analyzed for normality to ensure its suitability using standard multivariate analysis. The sample size from 50 and above used the Kolmogorov-Smirnov statistics results, while for sample size below 50, the Shapiro-Wilk statistics results were used. In this study, 0.05 was used as the cut-off value for the normality tests. It is vital to find the null hypothesis and the alternative hypothesis to test whether there is a difference between them. Also, it helps to ascertain whether the variables are normally distributed or not normally distributed.

The Kolmogorov-Smirnov statistical test was used in this study because the sample size of years of experience (five years or less) is more than 50, while the Shapiro-Wilk statistical test was also used because the sample size (more than five years) was less than 50. The normality test compares years of experience (five years or less and more than five years) against the influence of effective and new information flow on logistics management in Nigeria.

The normality test for the influence of effective and new information flow on logistics management revealed that the p-values (less than five years and more than five years) showed that it is less than 0.05. The null hypothesis (H_0) was rejected, and the alternative hypothesis (H_1) is accepted. Hence, it is not normally distributed. Therefore, there is a difference among the groups on how they view significant and new information flow on logistics management.

4.3. The Man-Whitney Test

The alternative hypothesis (H_1) was accepted because there is a difference between the groups. Hence, the Mann-Whitney (U) test was conducted. The Mann-Whitney (U) test is used to assess the changes connecting two independent groups on a continuous measure (Pallant, 2007). This study was done because the normality test revealed that most of the factors were not normally distributed. The years of experience were tested against the variables to ascertain whether respondents with five years or less experience and more than five years' experience had the same opinion.

The Mann-Whitney (U) test showed no significant difference in the influence of effective and new information flow on logistics management in Nigeria and respondents’ years of experience (five years or less) (Median (MD)= 4.000, no of respondents = 74) and those with more than five years (Median (MD) = 4.000, no of respondents = 32), U= 1125.000, Z-value = -0.407, P-value = 0.684.

5. Discussion of Results and Implications

Exploratory factor analysis was used in this study to categorize groups of related variables, determine their interrelationship, and decrease the variables into a more understood framework. The result of principal axis factoring showed the presence of one factor with eigenvalues larger than 1 as presented in Table 4. Owing to close inspection of the integral relationships among each of the variables under each factor, only one factor was generated. Factor 1 was named 'influence of effective and new information flow on logistics management'. The name used in describing factor 1 was derived by a close inspection of the variables within the factor. As shown in Table 3, the seventeen extracted factors for factor 1 were a smooth flow of material and products (86.0%), it helps in timely delivery (84.4%), expanded network (83.4%), negotiating better contracts (82.5%), better product tracking and forecasting reports (82.1%), enhanced information transfer between buyers and sellers (82.1%), increase in safety of goods (81.9%), smooth information flow to all logistics functions (81.5%), better quantity logistics information flow (79.8%), reduction of uncertainties (78.7%), more accurate costing (78.5%), better operational efficiency (77.9%), providing less expensive transportation nodes (76.5%), reduced lead time (76.2%), reduced inventory level (74.7%), and decrease in cost (67.8%). The number in parenthesis specifies the individual factor loadings. This group accounted for 65.711% of the variance, as shown in Table 4.

The normality test result revealed that the p-values (sample size of years of experience) against the influence of information flow on logistics management were less than 0.05. Therefore, the alternative hypothesis (H_1) is accepted. The Mann-Whitney results revealed that the comparison between the factor (influence of information flow on logistics management) against years of experience (five years or less and those having more than five years) does not show a significant difference since all respondents involved have the same opinion of the influence of information flow on logistics management in Nigeria.

The findings in this study are in agreement with studies conducted by Lofti (2013), Lai et al. (2005), Voortman, (2004) in which the authors identify the benefit of information flow within the supply/logistics management chain. These are achieved by identifying different parties within the firm's network and improving the business contacts. Some of the benefits include an increase in stock safety, reduction in inventory, a decrease in cost, reduction of uncertainties, enhanced resource utilization, better tracing and tracking, and negotiating better contracts. Also, the studies conducted by Fitzpatrick and Ali (2010) and Mourtzis (2011) are in line with the current study that new and adequate information flow enables firms to make better planning decisions in their operations such as improved utilization of resources, supply, and logistics chain costs minimization, better operational efficiency, and better responsiveness to customers' needs. Wong and Karia (2010) and Winkelhaus and Grosse (2019) also mentioned that information resources could help logistics management processes in the era of Industry 4.0, through; inventory monitoring, decrease in equipment errors, reduction of uncertainties, reduction in product delivery time, accurate tracing and tracking of fleets, and freight quality damage reduction.

It can be deduced from the study that negotiating better contracts was seen by the respondents as the best way to achieve practical and new information flow of logistics management in Nigeria. Likewise, better product tracking and forecasting reports, better quality logistics information flow, expanded networks, timely delivery, and enhanced information transfer between buyers and sellers are among many factors identified by the study, which can help achieve significant and new information flow of logistics management in Nigeria. As logistics chains become more significant and broader, it is essential to adopt efficient and effective logistics management information. Therefore, there is a need to improve the logistics management information flow in Nigeria because it will reduce waste such as inventory and non-value-added activities from suppliers to end consumers.

6. Conclusion and Future Perspectives

This research study has explored new information flow on logistics management in the Industry 4.0 era. From the findings, empirical findings conform to theoretical reviews. New information flow enables logistics firms to make better planning decisions in their operations, such as negotiating better contracts, better product tracking and forecasting reports, better quality logistics information flow, enhanced information transfer between buyers/sellers, timely delivery, improved resource utilization, supply and logistics chain costs minimization, and better responsiveness to customers' needs. Therefore, Nigerian logistics firms need to adopt a significant and new information flow in their logistics management processes because the growth of any logistics firm and its ability to compete globally with developed nations businesses depend on adequate information flow.

Since practical and new information flow enables logistics firms to make better planning decisions in their operations according to this study, it is recommended that logistic chain partners need to collaborate in choosing logistics information tools that will streamline their logistics chain processes for easy monitoring. It is also recommended that Nigerian logistics management bodies ensure that logistics firms adopt Industry 4.0 tools for a better flow of adequate and new information in their logistics management processes. Furthermore, a lot of sensitization and training of professionals, public, logistics managers, and stakeholders in the logistics management on Logistics 4.0 information systems should be encouraged for its adoption and practice to be generally accepted.

Full implementation of logistics information systems is necessary for tracking and tracing customer needs, better quality logistics information flow, planning, and controlling of intricate systems. Therefore, further studies can be conducted on the link between the implementation of logistics information systems and the reduction of uncertainties in the Nigerian logistics chain. Another future research direction is using an empirical model to understand the relationship between information flow and logistics management processes in Nigeria. Future studies could also look at how Nigerian organizations deal with the challenges of implementing logistics information systems in the Industry 4.0 era. Future reach direction can also be on logistics information systems and their influence on inter-organizational information sharing at several phases of the supply/logistics chain.

Conflict of Interests

Authors have declared that no conflict of interest exists.

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