OPEN ACCESS
World Journal of Arts, Education and Literature
ISSN: 3049-0766 | Vol. 3, No. 2, Feb. 2026
Website: https://wasrpublication.com/index.php/wjael

Human-Centric Logistics 5.0: Enhancing Workforce Productivity and Safety in Nigerian Logistics Operations

Dr. Jummai Zainab Umar-Ajijol[1*], Prof. Silva Opuala-Charles[2] and Prof. Henry O. Ozuru[3]

[1-3]Garden City Premier Business School, Plot 13 Herbert Macaulay Street, Old G.R.A, Port Harcourt, Rivers State, Nigeria.

Received: 02/12/2025	Accepted: 14/01/2026	Published: 27/02/2026

Abstract: The emergence of Logistics 5.0 has redefined operational paradigms in global supply chains by prioritizing human-centric systems that integrate advanced technologies with workforce well-being, productivity, and safety. In Nigeria, where logistics operations are characterized by infrastructural deficits, high occupational risks, and labour-intensive processes, the adoption of human-centric logistics remains both a strategic necessity and a developmental imperative. This study examined human-centric Logistics 5.0 as a framework for enhancing workforce productivity and safety in Nigerian logistics operations, with empirical evidence drawn from logistics firms operating in Nigeria. The study adopted a quantitative and explanatory survey research design. The population was 1200 employees of logistics firms in Port Harcourt, using Taro Yamen formula for sample determination, 300 logistics employees across warehousing, transportation, and supply chain management units was determined and administered copies of questionnaire, out of which 289 were returned and 280 were valid for analysis, representing a 96% effective response rate. Descriptive and Pearson Product Moment Correlation statistical techniques were employed to analyze the data and test the hypotheses. Findings revealed that human-centric Logistics 5.0 significantly improve workforce productivity and safety. The study concludes that the transition from traditional logistics systems to human-centric Logistics 5.0 is critical for sustainable productivity and workforce protection in Nigeria's logistics sector. It recommends strategic investment in smart safety technologies, workforce upskilling, ergonomic system design, and policy-driven digital transformation frameworks tailored to developing economies.

Keywords: Human-Centric Logistics 5.0, Workforce Productivity, workforce Safety, Nigeria.

1.0 Introduction

The logistics industry has changed a lot over the years. It has gone from manual, labor-intensive processes to very complex, technology-driven systems. These changes have made supply chain networks more integrated and effective (Xu et al., 2021). They are the result of globalization, new technologies, and changing business needs. The manufacturing industry is leading the way in new ideas and changes at a time when technology is advancing quickly and customer needs are changing. By improving performance via objective, data-driven decision-making in terms of effectiveness, efficiency, and service quality, Industry 4.0 enables businesses to become digital (Ferraro et al., 2023). As technology advanced, it became evident that human needs, sustainability, and resilience were critical considerations, leading to the emergence of Industry 5.0 (Commission et al., 2021). Industry 5.0 is different from earlier industries because it is based on values instead of technology. The notion that Industry 5.0 enhances and builds upon the fundamental characteristics of Industry 4.0 indicates that the two should be regarded as complementary or coexisting (Xu et al., 2021).

Logistics has gone through three main stages: the rise of Logistics 5.0, the move to Industry 4.0, and the way things used to be done. Every step has been important in changing how products are delivered, stored, and moved, which has an effect on how well people are managed and how well the business runs (Jafari et al., 2022). In the beginning, logistics relied mostly on people to do the work, with little help from technology. The main tools for processing orders, moving goods, keeping track of inventory, and storing goods were paper-based systems and manual tracking methods. These traditional methods worked well at the time, but they had some problems, like high error rates, long processing times, and limited scalability. Logistics 5.0 is different from earlier versions because it recognizes that people need to interact with each other in addition to digitalization. It also focuses on human-robot cooperation, green logistics, and improving quality of life (Bolatan, 2021). Human-Centric Logistics 5.0 is built on the larger idea of Industry 5.0, which values productivity, safety, human well-being, and technological innovation equally. Industry 5.0 uses smart operational systems that take into account human creativity, flexibility, and judgment. This change is especially important in poor countries like Nigeria, where logistics work is still very labor-intensive and dangerous.

Like this, planning for transportation relied on human judgment, which was useful but also prone to mistakes and inconsistencies. The absence of integrated communication systems exacerbated these challenges, leading to fragmented activities and diminished overall efficacy (Beatriz et al., 2024). The heavy reliance on manual processes also led to lower productivity and higher operating costs. There were inefficiencies across the supply chain

***Corresponding Author**

Dr. Jummai Zainab Umar-Ajijol*

Garden City Premier Business School, Plot 13 Herbert Macaulay Street, Old G.R.A, Port Harcourt, Rivers State, Nigeria.

as a consequence of employees being forced to do repeated operations that might have been automated. According to Alojaiman (2023), traditional logistics operations relied heavily on physical labor, which often led to higher labor costs and operational bottlenecks. The introduction of robotic systems, automated guided vehicles (AGVs), and automation technologies powered by artificial intelligence (AI) greatly improved operational efficiency. In warehouses, semi-autonomous and fully automated systems took the place of human-operated equipment. This cut down on mistakes and sped up order processing (Abdul-Rahim et al., 2022). Alojaiman (2023) says that using automation and AI in logistics has made supply chains more flexible and strong by making workers safer, lowering costs, and making them more productive.

Despite being strategically important, the sector has a lot of problems with its workforce, including unsafe working conditions, low productivity, high accident rates, poor employee well-being, operational inefficiencies, manual material handling, inadequate ergonomic systems, and limited technological integration. Global logistics research shows that worker productivity and safety have a big effect on how well the supply chain works and how efficiently it runs. In Nigeria, logistics workers are often in dangerous situations, such as driving for long periods of time, lifting heavy things, not having the right safety gear, and working in warehouses that aren't regulated. These things make work less efficient, make people tired, make them less happy with their jobs, and cause accidents at work. In addition, the logistics environment in Nigeria is marked by regulatory gaps, a lack of digital skills, and inadequate infrastructure, all of which impede the best possible labor performance. Operational resilience, employee morale, safety compliance, and overall organizational performance may all be enhanced by using a human-centric logistics paradigm. Thus, this study investigates how Human-Centric Logistics 5.0 can enhance workforce productivity and safety in Nigerian logistics operations, providing empirical and theoretical insights for policymakers, logistics firms, and supply chain stakeholders. Specific Objectives to:

i. Evaluate the relationship between human-centric logistics 5.0 and workforce productivity in Nigerian logistics operations.

ii. Assess the relationship between human-centric logistics 5.0 and workforce safety in Nigerian logistics operations.

2.0 Literature Review

2.1 Human-Centric Logistics 5.0

Lambert and Stock (2008) say that logistics is the process of planning, carrying out, and managing processes to move and store goods, services, and related data from the point of origin to the point of consumption in a way that meets customer needs. This includes movements that go in and out, as well as movements that happen inside and outside the organization. The logistics industry has changed a lot because of the industrial and technological revolutions. Logistics 1.0 focused on manual transportation and simple storage, while Logistics 2.0 added automation and set procedures. Logistics 3.0 came about because of globalization and supply chains that were connected to each other. Logistics 4.0 brought in automation, AI, the Internet of Things, and cyber-physical systems (Beatriz et al., 2024). Logistics 5.0 is the next stage, and it focuses on making the supply chain more resilient, sustainable, and focused on people. It makes a healthy operating environment by combining smart technology with people's skills, creativity, and health (Beatriz et al., 2024).

Logistics 5.0 has come about because of the need to meet customer needs in today's connected, digital, and rapidly changing global logistics market. This is done by focusing on Industry 4.0 and Industry 5.0 through the creation of smart logistics systems (Hasan et al., 2020). Logistics 5.0 is all about seamlessly adding new technologies while keeping and improving the human element. Romero et al. (2020) say that Human-Centric Logistics 5.0 is a logistics system that combines the latest technology with human intelligence, ergonomics, and well-being to boost operational performance while keeping workers safe and happy at work. "Human-Centric Logistics 5.0" is a strategic logistics idea that puts people at the center of technical systems. In logistics, it puts a lot of focus on collaborative robots, ergonomic systems, safety integration, and giving workers more power (Romero et al., 2020). Some important parts of logistics that focus on people 5.0 are: giving workers digital tools, smart decision-support systems, worker safety and ergonomics, human-machine cooperation, and sustainable logistical operations (Beatriz et al., 2024). The industrial sector has changed a lot since the rise of Industry 4.0. The main reason for this is the increasing digitization and interconnection of technologies like the Internet of Things (IoT), cyber-physical systems (CPS), artificial intelligence (AI), the digital twin (DT), machine learning (ML), collaborative robots, and others (Neumann et al., 2021).

Many scholars have pinpointed various technologies pertinent to the advancement of internal logistics. Wang (2016) emphasizes big data, intelligent sensors, RFID, the Internet of Things (IoT), the Internet of Services (IoS) (Andres et al., 2024), smart robots, and autonomous automated guided vehicles (AGV). Schmidtke et al. (2018) emphasize autonomous AGVs, mobile terminals, cloud IT platforms, IoT, and data mining, while Galindo (2016) focuses on RFID, CPS, IoT, IoS, Big Data, and RTLS. Choudhary (2024) concentrates on RFID, WLAN, EDI, GPRS, Big Data, Data Mining, Smartphones (Maddikunta et al., 2022), 5G networks, tablets, and cloud storage, whereas Wahrmann et al. (2019) discuss wearable scanners, voice-directed headsets (Hofmann & Rüsch, 2017), smart glasses, and activity trackers. Zou and Zhong (2018) looked into RFID, drones, self-driving AGVs, exoskeletons, and robots that work together. Bolatan (2021) talks about autonomous AGVs, smart robots, blockchain technology, CPS, drones, and big data as the last things. All of these technologies work together to make logistics operations inside the company more productive and efficient.

2.2. Workforce Productivity

Workforce productivity is the measure of how well logistics workers do their jobs, such as distribution, storage, packaging, and transportation. It includes their efficiency, output level, and performance efficacy. Workforce productivity (Ohuabunwa et al., 2023) is the study of how employees use their company's resources to reach its goals in the best way possible. These resources might include, but are not limited to, materials, tools, space, time, people, knowledge, information, money, and energy. The size and type of the business will determine what they are. A common way to figure out how productive an employee is is to divide their output by the resources they used in a set amount of time. Most of the time, these resources are called labor and capital at the organizational level. Creating more goods and services with the

same amount of resources is what makes productivity go up (Ebhoaye et al., 2022). In the service sector, where the transportation business is located, the amount of goods each person makes per resource does not determine their productivity. Instead, management needs to know how the service is provided and how happy customers are (Wright, 2018).

2.3 Workforce Safety

In Nigerian logistics, especially in freight and port terminal operations, the focus on worker safety is on lowering high-risk risks by using personal protective equipment (PPE), safety training, and following the rules.Effective safety management, which includes both personal and process safety (Eziekel-Hart & Eziekel-Hart, 2022), is closely linked to higher worker productivity and fewer disruptions to operations. Conducting comprehensive risk assessments, providing suitable personal protective equipment, ensuring adequate training, and adhering to Nigerian occupational safety and health regulations and workplace legislation are essential safety requirements that contribute to reducing injury rates (Wang et al., 2021). Safety is the first thing that every business, organization, or industry should care about. If you want to reduce risk, you need to use safety measures, especially in management processes where risk is unavoidable in production processes (Eziekel-Hart & Eziekel-Hart, 2022). Safety and ergonomics are the most important parts of warehouse management. They affect the health of workers, the effectiveness of operations, and the reputation of the company. Because of moving big things, using equipment, high storage systems, and doing the same physical tasks over and over, warehouses are often busy places. If you don't follow safety and ergonomic rules, you could face serious consequences, such as costly downtime, legal obligations, equipment damage, and worker injuries (Veľas et al., 2021; Kozjek & Ferjan, 2015; Boateng et al., 2018).

2.4 Human-Centric Logistics 5.0 and Workforce Productivity

Alojaiman (2023) asserts that user-friendly and adaptable technologies are crucial for sustaining the efficacy of human-machine collaboration. Without user-friendly interfaces and smart automation, employees may find it hard to use new technology in their daily work, which would lower overall performance. Logistics 5.0 combines the ideas of Industry 4.0 and 5.0 to make smart logistics systems for the global market that is connected digitally. It links people, machines, processes, and data to make warehousing, distribution, transportation, and inventory management better. Data processing, help systems, network integration, decentralization, and autonomy are all important functional areas that boost productivity, sustainability, and cooperation between people and machines. Logistics 5.0 enables mass customization, transparency, and performance through data interchange, while maintaining human oversight to manage procedures and system failures (Andres et al., 2024). Adding new technology to logistics makes it easier to handle and store things and keeps better track of where things are moving in real time (Hofmann & Rüsch, 2017). Most of the time, it depends on how many orders, items, or units each employee moves in an hour or shift (Ohuabunwa et al., 2023). Labor is still one of the most expensive parts of running a warehouse, especially in developing countries where automation is low. So, raising the productivity of workers has a direct effect on lowering costs, improving service delivery, and overall warehouse performance, in addition to being important for operational efficiency (Olabode et al., 2020). However, the following hypothesis is formulated:

Ho_1: There is no significant relationship between human-centric logistics 5.0 and workforce productivity in Nigeria logistics operations.

2.5 Human-Centric Logistics 5.0 and Workforce Safety

Logistics 5.0 has shown that automation can make workers happier by taking away tasks that are physically demanding and repetitive. This goes against the common belief that automation leads to job instability. Companies use AI-assisted systems and collaborative robots (cobots) to let their workers do less physical work and more meaningful work. Employees who work with AI and robots are happier at work because they have less stress from their workload and are more involved in jobs that add value (Gunasekaran et al., 2024). The use of IoT for real-time tracking gives employees more visibility and control over logistics operations. This lowers stress and increases productivity. AI-powered solutions are also being used more and more in warehouses to make stock management easier and more accurate. Logistics 5.0 puts a lot of emphasis on the professional growth and well-being of its employees, which creates a work environment that values both technical progress and human involvement. However, the following hypothesis is formulated:

Ho_2: There is no significant relationship between human-centric logistics 5.0 and workforce safety in Nigeria logistics operations.

2.6 Theoretical Framework

2.6.1 Theory of Safety and Security

This essay is based on "The theory of safety and security," which is related to Abraham Maslow's idea of Safety and Security. The perspective posits that crises are an inescapable phenomenon impacting human civilization. The negative effects of this are clear in the things that crises and security breaches have in common. It pertains to safety-oriented public sector entities and security-focused research. It characterizes crisis theory as a scientific discipline that focuses on the characteristics and origins of crises, prioritizing the theoretical aspects of crisis analysis. The method is mainly about preventing and managing crises (Eziekel-Hart & Eziekel-Hart, 2022). The hypothesis is dynamic. It looks into how crises start and grow, and it doesn't depend on any real-world example. The main point is that it has to do with how organizations deal with crises. It has recently been regarded as the apex of temporal paradoxes and a convoluted situation appropriate for the categorization of an era and the emergence of existential dilemmas.

One definition of a crisis is when danger is about to happen and the goal function of the reference object is also in danger, or when a system acts in a disorganized or chaotic way that changes the object's situation in a big way. During this time, the environment changes in different ways (Eziekel-Hart & Eziekel-Hart, 2022). This could be because of inputs, problems with production, power supply problems, or higher electrical voltage, among other unfortunate things. Maslow's theory says that safety is a basic human need. When logistics workers have to work in dangerous conditions, their motivation, output, and job satisfaction all go down. Human-Centric Logistics 5.0 meets safety standards in part by using smart safety solutions and making work spaces that are comfortable for the body. To adapt to every change, the system

needs to respond in a big way. The system can get ready for the right counteractions when it knows that changes are coming. But if there is a sudden and serious crisis, an inappropriate response could cause problems or a crisis. In short, safety and security nets are meant to protect people from unexpected and serious problems.

2.7 Empirical Review

Loo (2025) examined logistics industry 5.0 in Malaysia, focusing on the synergy between humans and machines in workforce management. This article investigates the shift from conventional logistics models to Logistics 5.0 within the Malaysian context, highlighting the crucial role of human-machine synergy in defining workforce management. This paper assesses the practical implementation, advantages, and benefits of integrating Logistics 5.0 concepts through a comprehensive literature review and an in-depth analysis of three Malaysian case studies. The results show that even though automation and AI make things more efficient and productive, human intuition, flexibility, and strategic oversight are still very important. The report ends with specific ideas for how to improve human-machine cooperation so that Malaysia's logistics industry stays strong, creative, and ready for the future in a time of rapid technological change.

Ebhoaye et al. (2022) looked at how to manage employee productivity and performance in Nigerian road transportation companies. They did this by looking at the relationships between the two variables and then looking at the relationships between two individual elements of performance management and employee productivity. The study used a survey research strategy, and the researchers wanted to know the total number of drivers for the top five road transportation companies in Nigeria in 2019. A questionnaire was used to collect data, and the correlation coefficient was used to find out which variables were related and how strong they were. The study found that all of the independent factors (performance management and its parts) had strong, positive, and significant relationships with the dependent variable (staff productivity). The correlation coefficients between employee productivity and the independent variables—employee compensation, employee appraisal, and performance management—were 0.979, 0.929, and 0.979, respectively. The relationships were found to be significant, as P.

Beatriz et al. (2024) examined enabling technologies to enhance supply chain logistics 5.0. This article examines the facilitating technologies that support both Industry 4.0 and Industry 5.0 within the context of supply chain logistics. The paper explains the ideas behind Logistics 5.0, which focuses on smart logistics solutions for customized distribution, transportation, inventory management, and warehousing. It emphasizes the importance of connecting, digitizing, and optimizing all supply chain processes. The traditional logistics framework necessitates innovative solutions grounded in emerging Industry 5.0 technologies that can collect and analyze extensive datasets to improve decision-making informed by data and insights. This advice aims to direct future research towards the practical application of technology in enabling Logistics 5.0.

3.0 Methodology

The study adopted an **explanatory survey research design** using a quantitative approach. The explanatory component investigates the causal relationship between Human-Centric Logistics 5.0 practices and workforce outcomes. This design is widely used in logistics, supply chain, and organizational performance studies where relationships between human-centric logistics 5.0 safety systems, and productivity are empirically tested. The population of the study comprises employees and management staff of registered logistics firms operating in major Nigerian logistics hubs, specifically: Rivers State (Port Harcourt logistics operations). The target population includes: Warehouse workers, Transport and fleet operators, Logistics managers, Supply chain analysts and Safety officers. Based on industry estimates and logistics firm records, the accessible population for the study is **1,200 logistics personnel** of 173 logistics firms in Port Harcourt (https://www.businesslist.com.ng/category/logistics/city:port-harcourt). The sample size for this study was determined using the Taro Yamane (1967) formula for finite population and we have three hundred (300) employees and management staff. The study employed a **multistage sampling technique,** which includes: Stratified Sampling, Logistics firms were stratified based on operational categories: Transportation companies, Warehousing firms, Third-party logistics providers (3PL) and Distribution companies; Simple Random Sampling, within each stratum, respondents were selected using simple random sampling to ensure equal representation and minimize sampling bias. Primary data were collected through structured questionnaires administered to logistics employees and managers. Data collected will be analyzed using both descriptive and inferential statistics with the aid of Statistical Package for Social Sciences (SPSS) version 26. Pearson Product Moment Correlation was used Hypotheses testing at 0.05 significance. A pilot study was conducted using 30 logistics workers outside the main sample frame. The reliability of the instrument was tested using **Cronbach's Alpha.**

Table 1: Reliability Test Results

Variable	Cronbach Alpha Value
Human-Centric Logistics 5.0	0.87
Workforce Productivity	0.84
Workforce Safety	0.89

In Table, all values exceed the acceptable threshold of 0.70, the instrument is considered reliable.

4.0 Data Presentation, Analysis and Results

The analysis is based on field survey data obtained from logistics firms in Nigeria. A total of 300 copies of the questionnaire were distributed to logistics personnel across selected logistics firms operating in Nigeria. Out of these, 289 questionnaires were returned, while 280 were found valid and usable for analysis after data screening.

Table 2: Questionnaire Distribution and Response Rate

Description	Frequency	Percentage (%)
Questionnaires Distributed	300	100
Questionnaires Returned	289	96.3
Valid Questionnaires	280	93.3
Invalid/Incomplete	9	3.0

In Table 2, the response rate of 96.3% is considered excellent for quantitative research and provides a reliable basis for statistical analysis. The high response rate is attributed to physical administration and follow-up within logistics firms in Nigeria.

Table 3: Job Position of Respondents

Job Role	Frequency	Percentage (%)
Warehouse Staff	82	29.3
Drivers/Fleet Operators	74	26.4
Logistics Managers	48	17.1
Safety Officers	31	11.1
Supply Chain Analysts	45	16.1
Total	280	100

Table 3 shows that warehouse staff and drivers constitute the majority of respondents, indicating that the study captured responses from core operational personnel who are directly exposed to productivity and safety issues in logistics operations.

Table 4: Years of Experience

Years of Experience	Frequency	Percentage (%)
1–5 Years	96	34.3
6–10 Years	88	31.4
11–15 Years	57	20.4
Above 15 Years	39	13.9
Total	280	100

Table 4 result indicates that most respondents have adequate industry experience, making their responses credible for assessing logistics productivity and safety practices.

Table 5: Educational Qualification

Qualification	Frequency	Percentage (%)
SSCE/OND	102	36.4
HND/B.Sc	128	45.7
M.Sc/MBA	38	13.6
Others	12	4.3
Total	280	100

Table 5 suggests that a significant proportion of respondents possess tertiary education, enhancing their understanding of human-centric logistics technologies and safety systems.

Table 6: Descriptive Statistics on Human-Centric Logistics 5.0

Items	Mean	Std. Dev	Decision
Human-machine collaboration improves efficiency	4.12	0.78	Agree
Ergonomic systems reduce worker fatigue	4.05	0.81	Agree
Digital training enhances employee performance	3.98	0.85	Agree
Smart safety technologies are used in operations	3.76	0.92	Agree
Automation supports workers rather than replacing them	4.01	0.83	Agree
Grand Mean	**3.98**	**0.84**	**Agree**

Table 6 results indicate a high level of agreement that human-centric logistics practices exist and positively influence operational processes in Nigeria logistics firms.

Table 7: Descriptive Statistics on Workforce Productivity

Items	Mean	Std. Dev	Decision
Technology improves task efficiency	4.15	0.73	Agree
Workers complete tasks faster with digital tools	4.08	0.76	Agree
Human-centric systems enhance job performance	4.11	0.79	Agree
Reduced fatigue increases productivity	4.20	0.71	Agree
Training improves operational output	4.09	0.82	Agree
Grand Mean	**4.13**	**0.76**	**Agree**

In Table 7, the grand mean of 4.13 indicates that Human-Centric Logistics 5.0 significantly enhances workforce productivity in Nigerian logistics operations.

Table 8: Descriptive Statistics on Workforce Safety

Items	Mean	Std. Dev	Decision
Smart safety devices reduce workplace accidents	4.18	0.74	Agree
Ergonomic tools improve worker safety	4.09	0.80	Agree
Safety training reduces occupational hazards	4.22	0.69	Agree
Human-machine collaboration reduces risk exposure	4.05	0.77	Agree
Safety monitoring systems enhance compliance	3.95	0.88	Agree
Grand Mean	**4.10**	**0.78**	**Agree**

Table 8 result shows that human-centric logistics systems significantly improve workplace safety in logistics firms in Port Harcourt.

4.1 Correlation Analysis

Table 9: Correlation Matrix

Variables	Human-Centric Logistics 5.0	Productivity	Safety
Human-Centric Logistics 5.0	1.000	0.721** (pv-0.000)	0.754** (pv-0.000)
Workforce Productivity	0.721** (pv-0.000)	1.000	0.689**(pv-0.003)
Workforce Safety	0.754** (pv-0.000)	0.689**(pv -0.003)	1.000

Correlation is significant at 0.05 level (2-tailed)

The results show a strong positive relationship between Human-Centric Logistics 5.0 and workforce productivity (r = 0.721) as well as workforce safety (r = 0.754). This implies that increased adoption of human-centric logistics practices leads to higher productivity and improved safety outcomes.

Hypothesis One: There is no significant relationship between human-centric logistics 5.0 and workforce productivity in Nigeria logistics operations. The null hypothesis one was rejected, as H_0 if $p < 0.05$. Human-Centric Logistics 5.0 has a significant positive relationship with workforce productivity in logistics operations in Nigeria.

Hypothesis Two: There is no significant relationship between human-centric logistics 5.0 and workforce safety in Nigeria logistics operations. The null hypothesis two was rejected, as H_0 if $p < 0.05$. Human-Centric Logistics 5.0 has a significant positive relationship with workforce safety in logistics operations in Nigeria.

The findings reveal that Human-Centric Logistics 5.0 significantly enhances workforce productivity and safety in logistics operations in Port Harcourt. The strong correlation between human-centric technologies and productivity confirms that digital training, ergonomic systems, and human-machine collaboration reduce fatigue and improve operational efficiency. Furthermore, the study shows that safety technologies such as smart monitoring systems and ergonomic tools reduce workplace risks and occupational hazards. This aligns with modern logistics transformation trends that prioritize human welfare alongside technological efficiency. The results also indicate that logistics firms that adopt human-centric systems experience better employee performance, reduced injury rates, and improved operational output. This is particularly relevant in Nigeria, where logistics operations remain labour-intensive and exposed to safety risks.

4.2 Discussion of Findings

Objective One: to evaluate the relationship between human-centric logistics 5.0 and workforce productivity in Nigerian logistics operations.

The findings from the descriptive statistics revealed a high grand mean score (4.13) for workforce productivity indicators, suggesting that the adoption of human-centric logistics 5.0 significantly improves productivity among logistics workers in Port Harcourt. Also, the result from inferential statistics show a strong positive relationship between Human-Centric Logistics 5.0 and workforce productivity ($r = 0.721$). This implies that when logistics firms integrate supportive technologies and worker-centered systems, employees are able to perform tasks more efficiently. In places where people work hard, like Nigeria, manual processes, bad ergonomics, and tiredness from working too much can all make productivity worse. The study shows that logistics strategies that put people first can help with these problems. This finding aligns with global logistics research demonstrating that human-machine collaboration enhances operational efficiency by reducing repetitive tasks and cognitive load on employees. The findings correspond with the studies conducted by Beatriz et al. (2024) and Loo (2025), which demonstrate that although automation and artificial intelligence improve efficiency and output, human intuition, adaptability, and strategic oversight are crucial. Ebhoaye et al. (2022) found that logistics 5.0 has strong, positive, and significant links to staff productivity.

Objective Two: to assess the relationship between human-centric logistics 5.0 and workforce safety in Nigerian logistics operations.

The analysis showed a strong agreement (grand mean = 4.10) that human-centric safety systems significantly improve workplace safety. Also, the result from inferential statistics show a strong positive relationship between Human-Centric Logistics 5.0 and workforce safety ($r = 0.754$). Logistics operations in Nigeria are often characterized by heavy manual lifting, unsafe warehouse conditions, and poor safety enforcement. The findings reveal that the integration of safety monitoring technologies plays a crucial role in minimizing workplace injuries and operational risks. This is particularly important in Port Harcourt logistics environments, where oil and gas logistics, warehousing, and transport operations expose workers to physical and environmental hazards. The findings are consistent with the studies conducted by Beatriz et al. (2024) and Loo (2025), which demonstrate that although automation and artificial intelligence improve efficiency and output, human intuition, adaptability, and strategic oversight are crucial. Ebhoaye et al. (2022) found that logistics 5.0 has strong, positive, and significant links to staff productivity.

5.0 Conclusion and Recommendations

The research, using data from logistics firms in Port Harcourt, concludes that Human-Centric Logistics 5.0 significantly enhances productivity and safety for employees in Nigerian logistics operations. The use of human-centered technologies, ergonomic systems, collaborative logistics tools, and analogous instruments significantly enhances productivity and safety in the workplace, diminishes the likelihood of accidents, and facilitates smoother operations. The research indicates that logistics operations in Nigeria remain mostly labor-intensive and encounter safety issues due to insufficient technological adoption and inadequate ergonomic infrastructure. Human-Centric Logistics 5.0 is a sustainable solution as it integrates technical advancement with employee welfare. The findings indicate that human-centered logistics systems do not replace human workers; rather, they enhance worker capabilities, increase job satisfaction, and foster a safer and more productive work environment. The Human-Centric Logistics 5.0 paradigm is particularly advantageous for underdeveloped countries such as Nigeria, where human labor remains integral to logistics and supply chain operations.

Based on the findings and conclusions of the study, the following recommendations are proposed:

i. Logistics firms in Nigeria should adopt human-centric technologies such as collaborative robots, smart warehouse systems, wearable safety devices, and AI-based logistics support tools to enhance productivity and safety.

ii. Organizations should invest in ergonomic workplace design, including automated lifting equipment, adjustable workstations, and fatigue monitoring systems to reduce workplace injuries and improve employee well-being.

iii. Logistics companies should implement regular training programs focused on digital skills, safety compliance, and human-machine collaboration to enhance workforce competence and adaptability to modern logistics technologies.

iv. Management of logistics firms should enforce strict occupational health and safety policies, including the provision of personal protective equipment (PPE), safety audits, and hazard monitoring systems.

v. Government agencies and regulatory bodies should promote human-centric industrial policies, provide incentives for smart logistics adoption, and strengthen labour safety regulations within the logistics sector.

vi. A national framework for Human-Centric Logistics 5.0 should be developed to guide logistics firms on integrating technology with workforce safety, productivity, and sustainability goals.

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