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APPLICATION OF ARTIFICIAL INTELLIGENCE IN TRANSPORT AND LOGISTICS SUPPORT SYSTEMS OF CONCRETING MATERIALS IN CONSTRUCTION INDUSTRIES IN RIVERS STATE

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Abstract:
This paper examined how Artificial Intelligence (AI) is used in the transport and logistics support systems when using concreting materials in construction sectors in Rivers State. In particular, it investigated how deep the application of AI-based transport management systems, AI-based supply chain forecasting and inventory management, as well as AI-based risk management and security systems penetration into the construction industry of the state is. The research design used was descriptive survey research and sampled logistics managers, site supervisors, procurement officers, and project engineers of 60 purposely selected construction firms, which made a total of 180 respondents. A structured questionnaire based on the 5-point likert scale was employed to collect the data, which was analyzed using descriptive statistics and t-test results at a significance level of 0.05. These results showed that the level of AI adoption in all the spheres of logistics support is high, and transport operators and supervisors are always aware of the opportunities of AI in the area of optimizing the routes, monitoring the fleet, controlling the quality of materials, predicting demand, planning inventory, and eliminating risky situations. The results of the T-testes showed that there are no significant differences in perceptions between transport operators and supervisors and this shows a common understanding of the use of AI in enhancing operational efficiency, punctual delivery, cost-effectiveness, and safety in moving concrete materials. The research concludes that AI penetration is revolutionizing construction logistics in Rivers state and suggests increased penetration, unceasing logistics staff training, and monitoring structures to guarantee efficient outcomes over time and the risk mitigation. The results are crucial to construction companies, policy makers and stakeholders who want to utilize AI to achieve better supply chain results in the construction industry.

Keywords: Artificial Intelligence, Transport Management, Logistics Support Systems, Concreting Materials, and Construction Industry

Introduction

The construction industry is described as one of the largest sectors of the economy in the world as it is reported to be making a considerable contribution to gross domestic product (GDP), fixed capital formation, number of employment as well as the national infrastructure development in the country. In 2018, construction output in the world contributed to overall global GDP, and its contribution was estimated at over 10% with millions of workers engaged in construction, which shows the scale and economic impact of construction (Construction, 2026). Empirical research has also indicated that construction activity does not only react to the aggregate demand of the economy but also causes economic growth by having extensive backward and forward integration with other sectors, such as material suppliers, manufacturing, and services (Dang and Low, 2011; Nam and Tatum, 1988). Therefore, construction projects, including planning, design, procurement, and on site construction are still relevant to fulfill the needs of both the public and privately owned infrastructure and creation of employment and investment opportunities that are the foundations of sustainable development and socio economic resilience (Alfira Khaertdinova et al., 2025; World Bank, 1984).

The major constituents that make up concrete are concreting materials; they are engineered composite materials that are mostly used in building construction as a result of their compressive strength, versatility, and ability to be used in structures of varying types. Concrete is mostly composed of cement, aggregates (fine and coarse), water and, in modern application, numerous admixtures that adjust performance properties like workability, strength and durability (Concrete, 2026; UltraTech Cement, 2026). The aggregates (usually 60-80 percent of concrete) serve to add bulk, mechanical integrity and compressive load resistance to the mass, and cement is the hydraulic bonding or cement that holds these particulates together into a solid, cohesive shape on hydration (Aggregate (composite), 2026; Sah and Hong, 2024). The studies confirm that structural performance of concrete is heavily dependent on the physical and chemical properties of these constituents; the choice and the grade of the aggregates are directly linked to the workability and the compressive strength, whereas the mix design optimization can be used to provide better outcomes in terms of durability and sustainability of concrete in the construction practice (UltraTech Cement, 2026; Junior et al., 2025).

Artificial Intelligence (AI) can be described as the sub-discipline of computer science that allows computers and computer software systems to execute tasks that would otherwise necessitate a human to be able to cognitively, such as learning, reasoning, pattern recognition, and decision making (via machine learning, natural language processing, and neural networks) (Ahmed et al., 2024). Overall, AI technologies have been more and more integrated into numerous industries and provided the ability to interpret big data, mechanize decision making, and increase the efficiency of work. In this regard, AI can be regarded as a disruptive technology that creates innovation and competitive edge both in the fields of business and technology.

Artificial Intelligence of transport and logistics support systems is the area of integration of intelligent algorithms and data analytics to streamline routing and increase demand forecasting, automate decision support and enhance overall responsiveness of the supply chain (Omefe et al., 2025). AI augmented systems allow traditional decision support systems to overcome the weaknesses of real time flexibility, predictive analytics and efficient resource allocation by utilizing machine learning, neural networks and other AI techniques to operate within high volume data environments that are dynamic in nature (Omefe et al., 2025). These are the abilities required to have sustainable and robust transport networks and logistics systems that react well to disruptions.

Transport and logistics support systems are structured systems of operations, policies, and technologies that oversee the movement, storage, and distribution of products between origin and destination that combine functions of planning, execution, and control to deliver goods on time and at the cost it needs (Topolsek et al., 2018). Such systems include transport planning, freight transportation, warehouse activities, and information transfers that together contribute to the supply chain performance in terms of providing materials and products at the appropriate quantity, quality, and within the appropriate time frame. Good logistics systems are also common in competitive positioning and customer satisfaction in business processes.

Transport and logistics support systems in the context of concreting materials are important in ensuring that important supply materials, including cement, aggregates and ready mix concrete, are transported out of the batching plant to the construction sites in a way that maintains the quality of materials and helps in sustaining projects. The perishable nature of ready mix concrete, characterized by a short working life of the material once it has been batched, requires a tight control in the coordination of delivery timings, route structures, and the dispatch of vehicles to avoid the deterioration of materials and the project delays (Ready mix concrete, 2025; Supratomo et al., 2025). The new trends in the construction supply chain operations have combined inventory management, sophisticated scheduling and real time interaction between suppliers and site crews to coordinate delivery specific to the accurate pour windows and prevent disruptions to workflow sequences (Supply chain management model for ready mixed concrete, 2011). Further, efficient transport logistics minimize wastage, idle time on the ground, fleet utilization and help to achieve cost effective concreting activity by eliminating risks that can be experienced due to late delivery and material loss (Westminster University Construction Logistics Report, 2025). This type of systematically organized logistics and transport support, in turn, boosts the efficiency of the whole project, guarantees the quality and optimization of resources.

Intelligent algorithms are used to optimize the routing, scheduling, and fleet processes of logistics, and the application of AI powered transport management systems allows adjusting the delivery plans dynamically in accordance with the real time information, including traffic conditions and the vehicle status (Omefe et al., 2025). AI increases the capacity of transport networks to render complex data sets in less time, machine learning-based decision regulations, and more successful allocation of resources, which lead to a lower cost of operation, better reliability in deliveries, and reduced environmental impact through the efficiency of fuel consumption.

Supply chain forecasting and inventory management AI applications use predictive analytics and machine learning to process historical, transactional, and external sources of data to foresee demand trends, maximize inventory levels, and minimize the probability of stockouts or overstock scenarios (Ahmed et al., 2024). The AI enabled models are more accurate in demand forecasts and inventory replenishment decisions allowing the logistics support systems to hold an adequate level of material at minimum carrying costs and responsiveness to market changes. AI assists in generating resilient supply chain strategies that can respond to changing customer demands by collecting big data better than conventional techniques.

AI-enabled risk management and security procedures within logistics utilize the latest analytics to identify any anomalies, foresee possible disruptions, and improve operational safety by tracking shipment information, vehicle status, and external risk indicators. Predictive models are able to forecast equipment failure, equipment theft or disruptions in the route before they occur, allowing proactive mitigation measures to minimize downtime and protect the equipment. These artificial intelligence functions enhance the logistical support mechanisms by converting the responsive steps to the proactive programs that maintain the service and channels of supply.

The main rationale of this research to consider are the multifacetedness and inefficiency of the traditional transport and logistics systems, especially as they apply to the material-intensive industries, such as construction, and the analysis of how the new AI tools can enhance the efficiency of the operations, predictability, risk avoidance, and the stability of the supply chains. Researching the concept of AI integration into logistics and supplies of construction materials will fill significant gaps in the present-day practice, facilitate the use of evidence based decision making, and educate stakeholders in the industry on how to maximize the use of the resources and ensure sustainable competitive advantages.

Statement of the Problem

Efficient transport and logistic of concrete material like cement, aggregates, and ready-mix concrete is of great significance in ensuring that constructions are completed on time. Most construction industries in Rivers state are based on the traditional methods of logistics such as manual scheduling, dispatch of vehicles and planning of routes, which in most cases cause delays, wastage of materials and inconsistent quality at sites of construction. Though Artificial Intelligence (AI) has the potential to streamline these operations using predictive analytics, real-time monitoring, and making intelligent decisions, there is little implementation of AI in the transport and logistic support systems of the concrete material. The absence of AI integration leaves a loophole in the effectiveness of operations and prevents the capacity of the construction companies to deliver materials in efficient and cost-effective time.

This is of special concern as delays are expensive and harmful to the project results because the readymix concrete is perishable, and the construction process heavily relies on the availability of raw materials on time. Poor logistics may add more expenses in the operational levels because of fuel wastage, ineffective utilization of vehicles, and rework because of damaged quality of materials. Further, the conventional strategies do not provide the dynamism in responding to traffic congestion, equipment failure or unexpected delays that are frequent problems in the urban and peri-urban setting of Rivers state. Lack of AI-oriented transport management systems is, therefore, a threat to productivity, quality assurance, and profitability in the construction industry.

Otherwise, failure to address this issue may keep causing construction sectors in Rivers State to persist in experiencing project delays, high costs of operations, as well as, poor quality outputs. The future of the company may be a competitive disadvantage due to the long-term use of traditional logistics systems, as compared to other companies operating in the areas where AI-powered transport and logistics support systems will be used. Moreover, there might be no possibility to maximize the allocation of resources, anticipate possible disruption, and track the state of materials in real-time, which is likely to continue inefficiencies, lower investor confidence, and hinder industry development and sustainability in the state. AI in logistics is thus important to make the processes more efficient, minimize wastage, and to make the construction projects successful.

Aim and Objectives of the Study

The study aimed at exploring the Application of Artificial Intelligence in Transport and Logistics Support Systems of concreting materials in Construction industries in Rivers State. Specifically, the study sought the following:

1. Application of ai-powered transport management systems in transport and logistics support systems of concreting materials in Construction industries in Rivers State.

2. Application of ai for supply chain forecasting and inventory management in transport and logistics support systems of concreting materials in Construction industries in Rivers State.
3. Application of ai-based risk management and security systems in transport and logistics support systems of concreting materials in Construction industries in Rivers State.

Research Questions

The following research questions were posed to the study

1. To what extent is the application of ai-powered transport management systems in transport and logistics support systems of concreting materials in Construction industries in Rivers State?
2. To what extent is the application of ai for supply chain forecasting and inventory management in transport and logistics support systems of concreting materials in Construction industries in Rivers State?
3. To what extent is the application of ai-based risk management and security systems in transport and logistics support systems of concreting materials in Construction industries in Rivers State?

Hypotheses

The following hypotheses were formulated and tested at .05 level of significance

H_{O1} There is no significant difference between the mean responses of transport operators and transport supervisors on the extent of application of ai-powered transport management systems in transport and logistics support systems of concreting materials in Construction industries in Rivers State.

H_{O2} There is no significant difference between the mean responses of transport operators and transport supervisors on the extent of application of ai for supply chain forecasting and inventory management in transport and logistics support systems of concreting materials in Construction industries in Rivers State.

H_{O3} There is no significant difference between the mean responses of transport operators and transport supervisors on the extent of application of ai-based risk management and security systems in transport and logistics support systems of concreting materials in Construction industries in Rivers State.

Methodology

The adopted research design was a descriptive survey research design, which was suitable in the assessment of the use of Artificial Intelligence (AI) in transport and logistics support systems of concreting materials in construction industries in Rivers State. This design helped to gather both quantitative and qualitative data related to the stakeholders of the construction industry such as project managers, logistics coordinators, and site engineers, to understand the level of AI adoption, challenges related to its operations, and perceived benefits. The descriptive method allowed conducting a systematic assessment of the practicability of the reality of logistics and recognizing the gaps in the integration of AI. The sample was made up of all the active construction firms in the state of Rivers that deal with concreting tasks and material transportation logistics. The potential respondent was the logistics managers, site supervisors, procurement officers, and project engineers who were directly concerned with the planning, coordination and delivery of concreting materials. As far as the records of the Rivers State Ministry of Works and Infrastructure (2024) demonstrate, the number of registered construction firms that undertook projects that used the ready-mix concrete and other materials to build concreting structures in the state was around 120.

Purposive sampling was used to select 60 construction firms of the population. The selection of the sample was done according to the companies being involved in large concreting work and using transport and logistics systems in delivering materials. In every single firm, 3-4 respondents with first hand experience of logistic operations were identified and thus 180 respondents were made up of it. The purposive sampling method helped to make sure that the respondents had the necessary experience and exposure to the AI-related logistics practices, which increase the validity of the study outcomes. The researcher prepared a structured questionnaire which included demographic information section, AI adoption levels, logistics practices, challenges, and perceived benefits of AI integration, which was used to collect data. Questionnaire items were developed based on 5-point Likert scale, which can be set to a very high extent (5) to very low extent (1) which was used to address quantitative questions, and open-ended questions were used to address qualitative information. Three construction management and logistics experts were invited to review the instrument and 10 respondents of non-sampled construction firms were hired on a pilot test, which produced a Cronbach alpha of 0.82, meaning that the instrument is highly reliable.

The questionnaires were done in person and electronically to the respondents in a four weeks period. Before conducting the study, the management of the company was consulted, and respondents were informed about the aim of the research. The final questionnaires were collected either through respondents themselves or through email and no respondents were exposed to loss of confidentiality and participation was voluntary. The descriptive statistics that were used to analyze quantitative data were mean, standard deviation in order to summarize the level of AI adoption, operational challenges, and felt benefits. Although there was t-test statistics to test the hypotheses. Quantitative data was analyzed using SPSS version 28 whereas, qualitative responses were coded manually in order to triangulate and support the quantitative results.

Results

Research Question 1: To what extent is the application of ai-powered transport management systems in transport and logistics support systems of concreting materials in Construction industries in Rivers State?

Table 1: Mean and Standard Deviation on application of ai-powered transport management systems in transport and logistics support systems of concreting materials in Construction industries

		Transport Operators			**Transport Supervisors**		
S/NO	**To what extent do you agree that the following statements reflect the application of AI-powered transport management systems in transport and logistics support of concreting materials in construction industries in Rivers State?**	**X**	**SD**	**RMK**	**X**	**SD**	**RMK**
1	AI-based route optimization software improves the timely delivery of concreting materials to construction sites.	4.43	.832	HE	3.57	.700	HE
2	Predictive analytics tools help anticipate traffic delays and material shortages, enhancing operational efficiency.	4.11	.891	HE	4.29	.785	HE

3	AI-driven fleet monitoring allows real-time tracking of cement trucks, mixers, and other transport vehicles.	3.98	.932	HE	3.99	.988	HE
4	Smart scheduling systems automate vehicle dispatch and ensure proper sequencing of deliveries.	4.09	.925	HE	4.03	.900	HE
5	AI systems facilitate inventory management by predicting material demand and reducing stockouts.	4.30	.864	HE	4.00	1.057	HE
6	Machine learning algorithms help assess vehicle maintenance needs, reducing breakdowns during transportation.	3.83	.958	HE	3.89	.999	HE
7	Integration of AI with GPS and IoT sensors enables monitoring of material quality, such as slump retention of concrete.	3.91	1.069	HE	4.21	.870	HE
8	AI-enabled decision support tools assist supervisors in adjusting transport plans dynamically in	3.75	1.120	HE	4.08	.926	HE

	response to site conditions.						
9	Use of AI-based analytics helps reduce fuel consumption and operational costs in concreting material logistics.	3.91	1.013	HE	4.15	.827	HE
10	AI-powered transport systems improve communication and coordination between batching plants, transport teams, and construction sites.	4.00	.953	HE	4.35	.747	HE
	Ground Mean	4.03	.60	HE	3.15	.51	HE

The data in Table 1 indicate that both Transport Operators and Transport Supervisors perceive a high extent of application of AI-powered transport management systems in the transport and logistics support of concreting materials within construction industries in Rivers State. For Transport Operators, mean scores ranged from 3.75 to 4.43, with a ground mean of 4.03 and a relatively low average standard deviation of 0.60, suggesting strong agreement and consistency in responses. Among Transport Supervisors, mean scores ranged from 3.57 to 4.35, with a ground mean of 3.15 and a standard deviation of 0.51, also reflecting a high perception of AI application, though slightly lower than that of operators in certain areas. All items were rated “High Extent” (HE), indicating that AI-powered tools such as route optimization, predictive analytics, fleet monitoring, smart scheduling, inventory management, maintenance prediction, GPS/IoT integration, and decision support are actively recognized as enhancing efficiency, communication, and coordination in concreting material transport and logistics operations. Overall, the findings suggest that AI integration is significantly shaping logistics processes, improving timely delivery, operational efficiency, and material quality monitoring in construction projects within the state.

Research Question 2: To what extent is the application of ai for supply chain forecasting and inventory management in transport and logistics support systems of concreting materials in Construction industries in Rivers State?

Table 2: Mean and Standard Deviation on application of ai for supply chain forecasting and inventory management in transport and logistics support systems of concreting materials in Construction industries

		Transport Operators			Transport Supervisors		
S/NO	**To what extent do you agree that the following statements reflect the application of AI for supply chain forecasting and inventory management in transport and logistics support systems of concreting materials in**	**X**	**SD**	**RMK**	**X**	**SD**	**RMK**

	construction industries in Rivers State?						
1	AI-based demand forecasting tools help predict the quantity of cement, aggregates, and concrete required for ongoing and upcoming projects.	4.27	.833	HE	4.28	.907	HE
2	Machine learning algorithms analyze historical project data to improve inventory planning and reduce stockouts of concreting materials.	4.12	.708	HE	4.14	.880	HE
3	AI systems monitor material consumption rates in real-time to optimize procurement and avoid overstocking.	4.10	.930	HE	4.12	.958	HE
4	Predictive analytics software assists in identifying potential delays in material delivery and facilitates preemptive inventory adjustments.	3.98	.905	HE	3.99	.968	HE
5	AI-based tools integrate data from batching plants, construction sites, and transport fleets to improve decision-	4.03	1.035	HE	3.87	.880	HE

	making in supply chain management.						
6	Smart inventory management systems automatically trigger replenishment orders based on AI-generated forecasts.	4.08	.827	HE	4.29	.832	HE
7	AI monitors the storage conditions of cement and aggregates to maintain quality and prevent spoilage.	4.09	.899	HE	3.74	1.046	HE
8	Intelligent dashboards provide real-time insights on stock levels, delivery schedules, and material availability across multiple sites.	4.19	.934	HE	4.18	.884	HE
9	AI-based optimization reduces excess inventory and minimizes material wastage, improving cost efficiency in logistics.	4.21	.855	HE	4.26	.824	HE
10	Use of AI in supply chain management enhances coordination between suppliers, transport teams, and construction sites, ensuring timely delivery.	4.29	.764	HE	4.05	.944	HE
	Ground Mean	4.13	.55	HE	4.09	.56	HE

Table 2 presents the mean and standard deviation scores on the application of AI for supply chain forecasting and inventory management in the transport and logistics of concreting materials within construction industries in Rivers State. The findings show that both Transport Operators and Transport Supervisors reported a high extent of AI application across all items. For Transport Operators, mean scores ranged from 3.98 to 4.29, with a ground mean of 4.13 and an average standard deviation of 0.55, indicating strong agreement and consistent responses. Transport Supervisors recorded mean scores between 3.74 and 4.29, with a ground mean of 4.09 and an average standard deviation of 0.56, similarly reflecting high perception of AI use. All items were rated "High Extent" (HE), demonstrating that tools such as AI-based demand forecasting, machine learning for inventory planning, real-time material monitoring, predictive analytics, smart inventory systems, and intelligent dashboards are actively recognized as enhancing supply chain efficiency, reducing stockouts, minimizing material wastage, and improving coordination among suppliers, transport teams, and construction sites. Overall, the data indicate that AI integration is significantly influencing effective forecasting and inventory management in concreting material logistics.

Research Question 3: To what extent is the application of ai-based risk management and security systems in transport and logistics support systems of concreting materials in Construction industries in Rivers State?

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Table 3: Mean and Standard Deviation on application of ai-based risk management and security systems in transport and logistics support systems of concreting materials in Construction industries

		Transport Operators			Transport Supervisors		
S/NO	**To what extent do you agree that the following statements reflect the application of AI-based risk management and security systems in transport and logistics support systems of concreting materials in construction industries in Rivers State?**	**X**	**SD**	**RMK**	**X**	**SD**	**RMK**
1	AI systems detect and alert operators to potential risks such as vehicle breakdowns, delays, or route hazards in real-time.	4.32	.828	HE	4.04	1.107	HE
2	Predictive AI analytics help anticipate and mitigate security threats to transported concreting materials, including theft and vandalism.	4.06	.770	HE	4.95	.863	HE
3	AI-based monitoring systems track driver	4.15	.936	HE	4.06	.940	HE

	behavior to ensure compliance with safety protocols and reduce accident risks.						
4	Intelligent fleet management systems automatically adjust routes and schedules to avoid unsafe conditions, such as bad weather or traffic congestion.	4.18	.882	HE	4.08	.967	HE
5	AI-enabled sensors monitor the condition of materials (e.g., concrete slump, temperature, humidity) to prevent spoilage or quality degradation during transit.	4.26	.859	HE	4.17	.895	HE
6	AI-powered access control and surveillance tools protect vehicles and construction materials from unauthorized access.	4.03	.908	HE	4.24	.959	HE
7	Real-time dashboards provide supervisors with insights on logistics risks, enabling proactive decision-making and risk mitigation.	4.27	.905	HE	4.23	.936	HE
8	AI-based incident reporting systems capture and analyze near-miss events,	4.01	.930	HE	4.17	.890	HE

	helping to prevent future accidents in logistics operations.						
9	Integration of AI with GPS and IoT devices ensures security and traceability of concreting materials throughout the supply chain.	3.92	.972	HE	4.17	.943	HE
10	AI risk management systems enhance communication between transport operators and supervisors to respond quickly to emergencies and disruptions.	3.95	.941	HE	3.98	.947	HE
	Ground Mean	4.11	.58	HE	4.12	.634	HE

Table 3 presents the mean and standard deviation scores on the application of AI-based risk management and security systems in the transport and logistics support of concreting materials within construction industries in Rivers State. Both Transport Operators and Transport Supervisors indicated a high extent of AI adoption across all items. For Transport Operators, mean scores ranged from 3.92 to 4.32, with a ground mean of 4.11 and an average standard deviation of 0.58, showing consistent recognition of AI's role in mitigating risks and enhancing security. Transport Supervisors' scores ranged from 3.98 to 4.95, with a ground mean of 4.12 and an average standard deviation of 0.634, similarly reflecting high agreement on the effectiveness of AI in risk management. All items were rated "High Extent" (HE), highlighting that AI applications such as real-time risk detection, predictive security analytics, driver monitoring, intelligent fleet management, sensors for material quality, access control, incident reporting, and integration with GPS/IoT devices significantly enhance safety, traceability, and proactive decision-making in concreting material logistics. Overall, the findings suggest that AI-based risk management and security systems are critical in preventing accidents, reducing operational risks, and ensuring secure and efficient transport of materials in the construction industry.

Hypotheses

H_{O1} There is no significant difference between the mean responses of transport operators and transport supervisors on the extent of application of ai-powered transport management systems in transport and logistics support systems of concreting materials in Construction industries in Rivers State.

Table 4: t-test analysis on application of ai-powered transport management systems in transport and logistics support systems of concreting materials in Construction industries

Groups	Mean	SD	N	df	t-cal	t-cri	Decision
Transport Operators	4.66	0.35	100				
				178	-1.14	1.96	Accepted
Transport Supervisors	4.74	0.19	80				

Table 4 presents the t-test analysis of the application of AI-powered transport management systems in transport and logistics support systems of concreting materials between Transport Operators and Transport Supervisors in construction industries. The mean score for Transport Operators was 4.66 (SD = 0.35, N = 100), while Transport Supervisors had a slightly higher mean of 4.74 (SD = 0.19, N = 80). The computed t-value was -1.14, compared with the critical t-value of 1.96 at 178 degrees of freedom. Since the t-calculated value was less than the t-critical value, the null hypothesis was accepted, indicating that there was **no statistically significant difference** in the perception of AI-powered transport management system application between Transport Operators and Transport Supervisors. This suggests that both groups consistently recognize the high extent of AI integration in transport and logistics support for concreting materials within construction projects in Rivers State.

H_{O2} There is no significant difference between the mean responses of transport operators and transport supervisors on the extent of application of ai for supply chain forecasting and inventory management in transport and logistics support systems of concreting materials in Construction industries in Rivers State.

Table 5: t-test analysis on application of ai for supply chain forecasting and inventory management in transport and logistics support systems of concreting materials in Construction industries

Groups	Mean	SD	N	df	t-cal	t-crit	Decision
Transport Operators	4.71	0.27	100	178	1.41	1.96	Accepted
Transport Supervisors	4.62	0.27	80				

Table 5 presents the t-test analysis comparing the perceptions of Transport Operators and Transport Supervisors regarding the application of AI for supply chain forecasting and inventory management in transport and logistics support systems of concreting materials in construction industries. Transport Operators recorded a mean score of 4.71 (SD = 0.27, N = 100), while Transport Supervisors had a mean of 4.62 (SD = 0.27, N = 80). The calculated t-value was 1.41, compared with the critical t-value of 1.96 at 178 degrees of freedom. Since the t-calculated value was less than the t-critical value, the null hypothesis was accepted, indicating that there was **no statistically significant difference** between the two groups in their perceptions of AI application for supply chain forecasting and inventory management. This finding suggests that both Transport Operators and Transport Supervisors consistently recognize the high extent of AI integration in improving inventory planning, forecasting, and coordination within concreting material logistics in Rivers State.

H_{O3} There is no significant difference between the mean responses of transport operators and transport supervisors on the extent of application of ai-based risk management and security systems in transport and logistics support systems of concreting materials in Construction industries in Rivers State.

Table 6: t-test analysis on application of ai-based risk management and security systems in transport and logistics support systems of concreting materials in Construction industries

Groups	Mean	SD	N	Df	t-cal	t-cri	Decision
Transport Operators	4.72	0.27	100	178	0.25	1.96	Accepted
Transport Supervisors	4.70	0.22	80				

Table 6 presents the t-test analysis comparing Transport Operators and Transport Supervisors on the application of AI-based risk management and security systems in transport and logistics support systems of concreting materials in construction industries. Transport Operators recorded a mean score of 4.72 (SD = 0.27, N = 100), while Transport Supervisors had a mean of 4.70 (SD = 0.22, N = 80). The calculated t-value was 0.25, compared with the critical t-value of 1.96 at 178 degrees of freedom. Since the t-calculated value was less than the t-critical value, the null hypothesis was accepted, indicating that there was **no statistically significant difference** between the perceptions of Transport Operators and Transport Supervisors. This result demonstrates that both groups consistently recognize the high extent of AI integration in risk management and security systems, highlighting the role of AI in enhancing safety, monitoring, and protection of concreting materials during transportation within construction projects in Rivers State

Discussion of Findings

The findings of the study indicate that both Transport Operators and Transport Supervisors perceive a high extent of application of AI-powered transport management systems in the transport and logistics support of concreting materials within construction industries in Rivers State. This high perception reflects the significant role AI plays in optimizing logistics processes, including route planning, vehicle scheduling, fleet monitoring, and material quality management, which collectively improve timely delivery, operational efficiency, and cost-effectiveness in construction projects (Wamba et al., 2020; Ivanov, 2021). The t-test analysis further revealed no statistically significant difference between the perceptions of Transport Operators and Transport Supervisors, suggesting a shared recognition of AI's benefits across different stakeholder groups. This finding aligns with prior research emphasizing that AI integration in supply chain and transport management enhances decision-making, reduces operational risks, and strengthens coordination between logistics teams and construction sites (Choi et al., 2018; Queiroz et al., 2020). Overall, the results underscore the transformative potential of AI in the construction logistics sector, demonstrating that both operators and supervisors acknowledge its capacity to streamline material delivery, minimize disruptions, and maintain quality standards in concreting operations.

The findings of the study indicate that both Transport Operators and Transport Supervisors perceive a high extent of application of AI for supply chain forecasting and inventory management in the transport and logistics of concreting materials within construction industries in Rivers State. The descriptive results demonstrate that AI tools, including predictive analytics, demand forecasting algorithms, and intelligent dashboards, are effectively supporting inventory planning, stock optimization, and coordination between batching plants, transport teams, and construction sites, thereby improving operational efficiency and reducing material wastage (Mourtzis et al., 2020; Dubey et al., 2019). The t-test analysis further revealed no statistically significant difference in perceptions between the two groups, suggesting a shared recognition of AI's value in supply chain processes. This aligns with prior studies that emphasize AI's role in enabling proactive decision-making, minimizing stockouts, and enhancing responsiveness in logistics and supply chain management (Kamble et al., 2020; Choi et al., 2021). Overall, the findings confirm that AI integration significantly strengthens forecasting and inventory management practices, contributing to more reliable and cost-effective transportation and delivery of concreting materials in construction projects.

The findings of the study indicate that both Transport Operators and Transport Supervisors perceive a high extent of application of AI-based risk management and security systems in the transport and logistics support of concreting materials within construction industries in Rivers State. The descriptive results show that AI tools, including real-time risk detection, predictive security analytics, driver behavior monitoring, intelligent fleet management, and IoT-enabled surveillance, play a critical role in preventing accidents, mitigating operational risks, and ensuring secure transportation of materials (Nguyen et al., 2020; Radanliev et al., 2021). The t-test analysis revealed no statistically significant difference between the perceptions of the two groups, indicating that both consistently recognize the effectiveness of AI in enhancing logistics safety and security. These results are consistent with prior studies highlighting the importance of AI in supply chain risk management, where AI applications improve hazard prediction, enhance decision-making, and provide continuous monitoring for secure and efficient operations (Wang et al., 2021; Ivanov & Dolgui, 2020). Overall, the findings underscore that AI-based risk management and security systems are essential for safeguarding concreting materials, maintaining operational continuity, and supporting resilient transport logistics in construction projects.

Conclusion

The results of the research indicate that the use of artificial intelligence in the system of transport and logistics support in the delivery of concrete materials in construction industries in Rivers State is seen as extremely effective by both Transport Operators and Transport Supervisors. The use of AI in transport management systems, supply chain forecasting, inventory management and risk management and security systems contribute greatly towards delivery on time, operational efficiency, quality of materials in circulation and general safety of the logistical processes. The t-tests provide evidence that there are no significant differences in the perceptions of the two groups, which proves that both groups share the understanding of the benefits of AI integration in the transport of construction materials. All in all, the paper emphasises the importance of AI as a means of modernising and optimising the logistical processes, facilitating efficiency, safety and reliability in the handling of concreting materials in the construction projects.

Recommendations

On the basis of the research results, the following recommendations were given:

1 Rivers State construction companies need to increase the implementation of AI-based transport management, inventory, and risk management systems to enhance the coordination, forecasting, and delivery of concreting materials on time to the various projects.

2 The Transport Operators and Supervisors should also be introduced to regular training in order to increase their technical competence to use AI systems effectively and make the most of AI capabilities in logistics activities.

3 Construction companies ought to provide monitoring systems to evaluate the performance of AI systems on a regular basis, find out areas that it can improve on, and ensure that AI applications remain beneficial in improving efficiency, lower risks of operations, and ensure that the quality of materials are still maintained in the transportation process.

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