

## **ROAD TRANSPORT NETWORK DESIGN AND ORGANIZATIONAL SUCCESS OF LOGISTICS COMPANIES IN RIVERS STATE, NIGERIA**

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### **Abstract**

This study investigated the relationship between road transport network design (RTND) and success of logistics companies in Rivers State. The study adopted a survey research design with a correlational investigation type. The study was conceptualized using RTND as predictor to organizational success with measures such as waste reduction, cost reduction and on-time delivery. The population of the study consisted 20 major logistics companies in Rivers State which are also registered with the Nigerian directory and search engine (2022). The researcher adopted the entire population as the sample size. The study administered questionnaire on the operations manager and logistics manager of each of the firms. Pearson's Product Moment Correlation (PPMC) was used to test the hypotheses formulated. The Statistical Packages for Social Sciences Version 23.0 facilitated the tests. The results reveal the existence of significant relationship between RTND and success of logistics companies in Rivers State. Based on the findings, the study concluded that RTND significantly relates to success of logistics companies in Rivers State; and recommends that managers of logistics companies should strategically plan their routes and entire road networks to facilitate efficient movement of goods and people, this is expected guarantee their success.

**Keywords:** Cost reduction, on-time delivery, organizational success, road transport network design, waste reduction

### **Introduction**

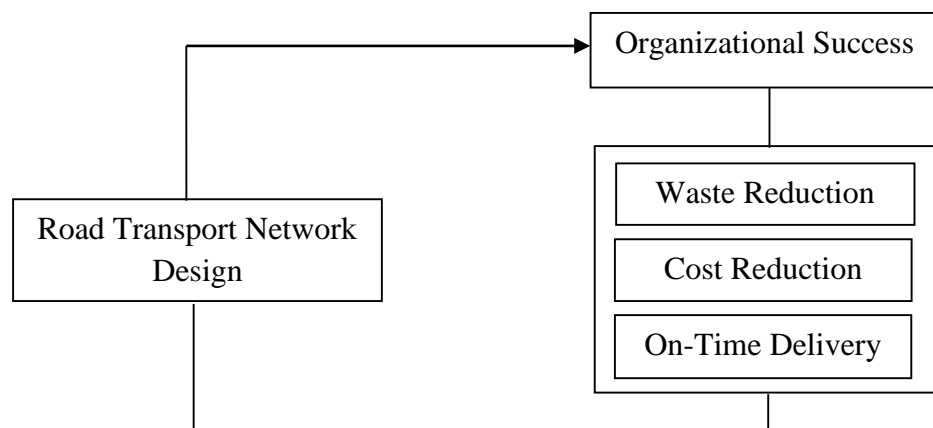
Transportation is a vital economic and social aspect of every society, serving the function of moving goods and individuals and as the backbone of economic development (Priyatiningsih & Sutrisno, 2020). Transport infrastructure such as a road network is frequently cited in the academic literature as key to promoting success in logistics operations (Sénquiz-Díaz, 2021). Road transport system provides appropriate infrastructure for facilitating trade in a society (Tuong et al., 2019). Designing road transport systems with considerations for traffic patterns, congestion, and potential delays improve timeliness and reliability of deliveries; even as logistics firms that consistently meet or exceed delivery expectations are more likely to retain customers and secure repeat business (Adu et al., 2023).

Effective road transport network design contribute to better service levels, including faster deliveries, accurate tracking, and fewer disruptions. Meeting or exceeding customer expectations enhances satisfaction levels and fosters positive relationships, leading to customer loyalty and referrals. Customers desire reliable movement of goods, timely and accurate travel information, safe and quick incident clearance, and greater options in transportation modes, routes and services (Priyatiningsih & Sutrisno, 2020).

To address the need for mobility, safety and security, many logistics companies have integrated transport designs into their solution sets. Logistics companies prioritize road designs to help them

manage uncertainties (Tuong et al., 2019). Designing road transport systems that are adaptable to changing market demands, seasonal fluctuations and unforeseen disruptions (e.g., weather events, road closures) enable logistics companies maintain operational flexibility and responsiveness (Priyatiningsih & Sutrisno, 2020).

Scholars and researchers agree that transportation infrastructure, including road network designs facilitate economic development. And though there are several studies that depict relationship between road transport network design and organizational success (Hsu & Wang, 2015; Lai & Wong, 2012), there is paucity of empirical studies showing the relationship between road transport network design and success of firms in Rivers State. Thus, this study explored the relationship between road transport network design and success of logistics companies in Rivers State.



**Fig. 1:** Conceptual framework of the relationship between road transport network design and success of logistics companies in Rivers State.

### Theoretical Foundation of the Study: Resource-Based View (RBV)

RBV (Wernerfelt, 1984, Barney, 1991) is a strategic management model that emphasize the significance of a firm's distinct resources and skills as primary factors that determine competitive advantage and long-term success (Nwulu & Nadube, 2022). RBV argues that a firm's competitive advantage stems from its possession of distinctive and valuable resources, encompassing physical assets, capabilities and knowledge (Priyatiningsih & Sutrisno, 2020).

The assumption of RBV is that resources and capabilities are not easily transferable between firms and that organizations have different resources and capabilities even within the same industry. By recognizing road transport network design as a vital and possibly distinctive resource, companies can exploit it to optimize asset usage, minimize expenses, and eventually attain a competitive edge in asset management within the supply chain.

### Road Transport Network Design

Road transport means transportation of goods and personnel from one place to the other on roads. Road is a route between two destinations, which has been either paved or worked on to enable movement of motorised and non-motorised carriages (Priyatiningsih & Sutrisno, 2020). Road transport network design decisions involve strategic choices made in the planning, development, and management of road networks (Skorobogatova & Kuzmina-Merlino, 2017). Road transport network design (RTND) is the process of determining the overall structure, layout and connectivity of road network, including decisions on location and hierarchy of roads, interconnections between transportation corridors, and the integration of various modes of transport.

In supply chain practice, RTND includes the design of junctions where logistics vehicles meet, intersection types (e.g., signalized, roundabout), turning radii, lane configurations, pedestrian facilities, and traffic control measures to optimize traffic flow and safety (Priyatiningsih & Sutrisno, 2020). It also includes the design and placement of traffic control devices such as signs, signals, pavement markings, and delineators to regulate traffic flow, guide drivers, and enhance safety on the road network (Fanai et al., 2022). The inclusion of safety elements such as guardrails, crash cushions, rumble strips, lighting, and visibility enhancements to reduce the risk of accidents and minimize their severity are crucial in RTND.

### **Organizational Success**

Organizational success is an indicator goal attainment and a firm's aptitude to compete or outcompete others (Ali, 2018). It reflects a firm's ability to survive, continue and perpetuate, and achieve goals, through management and workers performing tasks and duties entrusted to them in the best way (Kaliannan & Adjovu, 2015). From Salah's (2019) point of view, the success of an organization depends on its ability to manage well, which enables it to obtain renewable knowledge, experiences, building ideas, successful analysis of experiences and skills, and the organization's competitive history in the same sector. Success is measured by analyzing where the organization is in regards to its goals and its mission. This study adopts waste reduction, cost reduction and on-time delivery as measures of organizational success.

Waste reduction is a waste management approach that focuses on minimizing the amount and toxicity of hazardous waste generated (Adewumi & Otali, 2013). Waste minimization techniques focus on preventing waste from ever being created, otherwise known as source reduction, and recycling. These techniques can be practiced at several stages in most waste generating processes, but require careful planning, creative problem solving, changes in attitude, sometimes capital investment, and genuine commitment (Ameh & Itodo, 2013).

Cost reduction is the accomplishment of a real and long-lasting decrease in the unit cost of goods produced or services provided, without compromising the ability of the product to fulfill its intended function. Reduction of costs is achieved at unit levels where accumulation of costs helps to alter physical attributes that makes the unit to become more and more efficient.

On-time delivery (OTD) refers to how many orders are completed in a specified time frame. It means dispatching items to customers as per agreed delivery schedules. On-time delivery directly influences customer perception, with delayed shipments often resulting in dissatisfaction and diminished brand reputation. Summarily, OTD means that a company will fulfill its delivery commitment based on the agreed time, which is known as the delivery date and time.

### **Road Transport Network Design and Organizational Success**

Studies on relationship between road transport network design and organizational success have been documented in literature. For instance, Adu et al. (2023) examined road transport infrastructure and supply chain performance in beverage manufacturing setting. The results showed a direct significant relationship between road transport infrastructure, road safety compliance, and supply chain performance. The findings further revealed that the influence of road transport infrastructure on supply chain performance is not just a bivariate relationship but also mediated through road safety compliance.

Nwulu and Nadube (2022) examined the connection between supply network design decisions and service quality of paint manufacturing firms in Rivers State. The study found that supply network design decisions (facility location, transportation mode and vehicle routing) have strong, positive

and statistically significant association with service quality, with transportation mode and service quality having the strongest link.

Sénquiz-Díaz (2021) studied effects of transport infrastructure quality on logistics performance of exports of goods in 29 developing economies based on micro fixed-effects panel data for the period 2012–2018. The results revealed that quality of roads and ports contribute significantly to higher exports in developing economies. In their study on sustainable transportation practices of multinational manufacturing companies, Wanjohi (2020) found the existence of relationship between sustainable transportation practices and operational performance.

Lu et al. (2019) investigated environmental logistics performance index (ELPI) for assessing the overall performance in green transportation and logistics practices of 112 countries. The study found that green transportation is strongly correlated with logistics performance. Similarly, sustainable transportation practices have been associate with improved business performance (Logeshe, 2017; Pembere, 2016), cost reduction (Diane, 2016) competitiveness of firms (Mwaura et al., 2016).

On the strength of the foregoing, the present study puts forward the following hypotheses:

**H<sub>A1</sub>:** RTND significantly relates to waste reduction of logistics companies in Rivers State.

**H<sub>A2</sub>:** RTND significantly relates to cost reduction of logistics companies in Rivers State

**H<sub>A3</sub>:** RTND significantly relates to on-time delivery of logistics companies in Rivers State.

### Methodology

This study adopts a survey research design with a correlational investigation type. The population of the study comprised 20 major logistics companies in Rivers State which are also registered with the Nigerian directory and search engine (2022). The researcher adopted the entire population as the sample given that the small population size. The study administered copies of questionnaire to the operations manager and logistics manager of each of the firms. With the help of Statistical Packages for the Social Sciences (SPSS) version 23.0, Pearson's Product Moment Correlation (PPMC) was used to test the hypotheses to figure out the relationship between RTND and success of logistics companies in Rivers State.

**Table 1: Reliability Test - Cronbach's Alpha Analysis**

S/N	Variables	Number of Items	Cronbach's Alpha Coefficients
1	RTND	3	0.925
2	Waste Reduction	3	0.725
3	Cost Reduction	3	0.778
4	On-Time Delivery	3	0.750

Source: SPSS Output form field data

As shown in Table 1, the results of the Cronbach's alpha analysis revealed that all the variables in the study produced high Cronbach's Alpha coefficients indicating that, there is inter-item consistency among the variables in the study. This means that, if this study is conducted again in similar condition, the results would be similar to the results of our study.

## Results and Interpretations

**Table 2: Descriptive Statistics of Road Transport Network Design**

Descriptive Statistics	N	Sum	Mean	Std. Dev.	Variance
To what extent does your organization deliver goods between cities, towns and small villages through road transport?	35	133	3.80	1.389	1.929
To what extent does your organization enjoy the advantage of door-to-door delivery of goods and materials as well as cost-effective means of cartage, loading and unloading enabled by road transport?	35	157	4.49	.887	.787
To what extent does your organization consider design of junctions where logistics vehicles meet, intersection types (e.g., signalized, roundabout), turning radii, lane configurations, pedestrian facilities, and traffic control measures to optimize traffic flow and safety?	35	138	3.94	1.136	1.291
To what extent does your organization track goods locations, monitor driver performance, and analyse all costs involved in transportation?	35	173	4.94	.338	.114
Valid N (listwise)	35				

Source: SPSS Output, 2024.

Table 2 depicts high mean scores of the questionnaire items ranging over 3.00, this means that greater number of the respondents expressed very high and high extents of acceptance to the research question with respect to road transport network design. However, it can be seen that question 4 which sought to determine the extent to which logistics companies in Rivers State track goods locations, monitor driver performance, and analyse all costs involved in transportation, has the highest mean score of 4.94. This shows that question 4 has the strongest influence on the variables.

**Table 3: Descriptive Statistics of Waste Reduction**

Descriptive Statistics	N	Sum	Mean	Std. Dev.	Variance
To what extent have you been able to implement source reduction strategies to minimize waste generation at the initial stages of production?	35	144	4.11	1.105	1.222
To what extent have you been able to promote the reuse and repurposing of materials and products within your operations?	35	164	4.69	.471	.222
To what extent have you been able to establish and maintain efficient recycling programs for different types of waste generated by your organization?	35	157	4.49	.507	.257
To what extent have you been able to conduct regular waste audits to identify and optimize waste management processes	35	158	4.51	.887	.787
Valid N (listwise)	35				

Source: SPSS Output, 2024.

Table 3 depicts high mean scores of the questionnaire items ranging over 3.00, this means that greater number of the respondents expressed very high and high extents of acceptance to the research question with respect to waste reduction. However, it can be seen that question 2 which sought to determine the extent to which logistics companies in Rivers State have been able to promote the reuse and repurposing of materials and products within their operations, has the highest mean score of 4.69. This shows that question 2 has the strongest influence on the variables.

**Table 4: Descriptive Statistics of Cost Reduction**

Descriptive Statistics	N	Sum	Mean	Std. Dev.	Variance
To what extent have you been able to identify and prioritize key areas for cost reduction across different departments and operations?	35	148	4.23	1.285	1.652
To what extent have you been able to negotiate better terms with suppliers and achieve procurement savings?	35	152	4.34	1.110	1.232
To what extent have you been able to invest in process improvements and automation technologies to reduce operational costs?	35	166	4.74	.443	.197
To what extent have you been able to encourage employee involvement in identifying and implementing cost-saving measures?	35	149	4.26	1.268	1.608
Valid N (listwise)	35				

Source: SPSS Output, 2024.

Table 4 depicts high mean scores of the questionnaire items ranging over 3.00, this means that greater number of the respondents expressed very high and high extents of acceptance to the research question with respect to cost reduction. However, it can be seen that question 3 which sought to determine the extent to which logistics companies in Rivers State have been able to invest in process improvements and automation technologies to reduce operational costs, has the highest mean score of 4.74. This shows that question 3 has the strongest influence on the variables.

**Table 5: Descriptive Statistics of On-Time Delivery**

Descriptive Statistics	N	Sum	Mean	Std. Dev.	Variance
To what extent have you been able to prioritize on-time delivery as a critical performance metric in your strategic planning and daily operations?	35	139	3.97	1.445	2.087
To what extent have you been able to utilize advanced forecasting and inventory management systems to ensure timely availability of products and materials?	35	165	4.71	.572	.328
To what extent have you been able to collaborate with logistics partners to optimize transportation routes and improve delivery reliability?	35	155	4.43	.655	.429
To what extent have you been able to identify and mitigate potential risks that could impact on-time delivery performance?	35	167	4.77	.598	.358
Valid N (listwise)	35				

Source: SPSS Output, 2024.

Table 5 depicts high mean scores of the questionnaire items ranging over 3.00, this means that greater number of the respondents expressed very high and high extents of acceptance to the research question with respect to on-time delivery. However, it can be seen that question 4 which sought to determine the extent to which logistics companies in Rivers State have been able to identify and mitigate potential risks that could impact on-time delivery performance, has the highest mean score of 4.77. This shows that question 4 has the strongest influence on the variables.

**Table 6: Relationship between Road Transport Network Design and Waste Reduction Correlations**

		RTND	Waste Reduction
RTND	Pearson Correlation	1	.548**
	Sig. (2-tailed)		.001
	N	35	35
Waste Reduction	Pearson Correlation	.548**	1
	Sig. (2-tailed)	.001	
	N	35	35

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS Output, 2024.

Table 6 reveals a correlation coefficient of 0.548\*\* between RTND and waste reduction, indicating a moderate positive relationship between RTND and waste reduction. More so, the probability value (0.000) is less than the critical value (0.05), this shows that there is a significant relationship between RTND and waste reduction. This further implies that RTND can be used to achieve waste reduction among logistics companies in Rivers State. Thus, we accept the alternate hypothesis that there is significant relationship between RTND and waste reduction of logistics companies in Rivers State.

**Table 7: Relationship between Road Transport Network Design and Cost Reduction Correlations**

		RTND	Cost Reduction
RTND	Pearson Correlation	1	.837**
	Sig. (2-tailed)		.000
	N	35	35
Cost Reduction	Pearson Correlation	.837**	1
	Sig. (2-tailed)	.000	
	N	35	35

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS Output, 2024.

Table 7 reveals a correlation coefficient of 0.837\*\* between RTND and cost reduction, indicating a very strong positive relationship between RTND and cost reduction. More so, the probability value (0.000) is less than the critical value (0.05), this shows that there is a significant relationship between RTND and cost reduction. This further implies that RTND can be used to achieve cost reduction among logistics companies in Rivers State. Based on this, we accept the alternate hypothesis that there is a significant relationship between RTND and cost reduction of logistics companies in Rivers State.

**Table 8: Relationship between Road Transport Network Design and On-Time Delivery Correlations**

		RTND	On-Time Delivery
RTND	Pearson Correlation	1	.656**
	Sig. (2-tailed)		.000
	N	35	35
On-Time Delivery	Pearson Correlation	.656**	1
	Sig. (2-tailed)	.000	
	N	35	35

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Source: SPSS Output, 2024.

Table 8 reveals a correlation coefficient of 0.646\*\* between RTND and on-time delivery, indicating a strong positive relationship between RTND and on-time delivery. The probability value (0.000) is less than the critical value (0.05), this shows that there is a significant relationship between RTND and on-time delivery. This further implies that road transport network de RTND sign can be used to achieve on-time delivery among logistics companies in Rivers State. Based on this, we accept the alternate hypothesis that there is a significant relationship between RTND and on-time delivery of logistics companies in Rivers State.

### Discussion of Findings

The analysis revealed that RTND has moderate positive and statistically significant relationship with waste reduction; a very strong positive and statistically significant relationship with cost reduction; and a strong positive and statistically significant relationship with on-time delivery.

These findings corroborate the findings of Adu et al. (2023) that a direct significant relationship exists between road transport infrastructure, road safety compliance, and supply chain performance; and that of Nwulu and Nadube (2022) that supply network design decisions (facility location, transportation mode and vehicle routing) have strong, positive and statistically significant association with service quality.

Similarly, the findings are in tandem with postulation that quality of roads and ports contribute significantly to higher exports in developing economies (Sénquiz-Díaz, 2021); and that there is relationship between sustainable transportation practices and operational performance (Wanjohi, 2020). Also, the findings of this study align with the report that green transportation is strongly correlated with logistics performance and environmental performance (Lu et al., 2019).

### Conclusion and Recommendations

RTND is a key decision focused on promoting organizational success. This study assessed the connection between RTND and organizational success. Sequel to the findings, the study concludes that RTND has positive significant relationship with success of logistics companies in Rivers State; and recommends that:

- i. Managers of logistics companies should strategically plan their routes and entire road networks to facilitate the efficient movement of goods and services aimed at achieving organizational success.
- ii. Managers of logistics companies should design transport routing for deliveries with specific time windows, especially in metropolitan areas where congestion and customer schedules are significant concerns, this will guarantee on-time delivery overall organizational success.

### References

- Adu, J. P., Dorasamy, N. & Keelson, S. A. (2023). Road transport infrastructure and supply chain performance in the beverage manufacturing setting: Does road safety compliance matter? *Journal of Law and Sustainable Development*, 11(3), 581-595.
- Ali, A. J. M. (2018). The effect of talent management in achieving organizational success: a field study in the General Company for Dairy Products in Baghdad. *Journal of Economic and Administrative Sciences*, 106 (24), 203-225.



- Bayoumi, E., Elgazzar, S., Abdelbary, A. & Ricci, S. (2021). The role of road transport infrastructure investments on logistics performance: A research agenda. *International Business*, 1(2), 71-83.
- Fanai, S. & Mohammadnezhad, M. (2022). The perception of public transport drivers (PTDs) on preventing road traffic injury (RTIs) in Vanuatu: A qualitative study. *International Journal of Qualitative Studies on Health and Well-Being*, 17(1), 204-221.
- Karia, N., & Asaari, M. H. A. H. (2016). Transforming green transportation practice into benefits: a case of third-party transportation (3PLs). In International Conference on Industrial Engineering and Operations Management, Kuala Lumpur, Malaysia.
- Lu, M., Xie, R. Chen, P., Zou, Y. & Tang, T. (2019). Green transportation and logistics performance: An improved composite index. *Sustainability*, 11, 297-316.
- Nwulu, C. S. & Nadube, P. M. (2022). Supply network design decisions and service quality: Insights from paint manufacturing firms in Rivers State. *Nigerian Journal of Management Sciences*, 23(1), 106-116.
- Priyatiningsih, K., & Sutrisno, M. (2020). Road infrastructure asset management strategy and its impact on the environment. *IOP Conference Series: Materials Science and Engineering*, 830(2), 220-230.
- Saghapour, T.; Moridpour, S., Thompson, R. (2019). Sustainable transport in neighborhoods: Effect of accessibility on walking and bicycling. Transportation. A *Transportation Science*, 15, 849–871.
- Sénquiz-Díaz, C. (2021). Transport infrastructure quality and logistics performance in exports. *Economics*, 9(1), 107-124.
- Skorobogatova, O. & Kuzmina-Merlino, I. (2017). Transport infrastructure development performance. *Procedia Engineering*, 17 (8), 319-329.
- Tuong, P. V., Binh, D. T. & Hoa, N. D. (2019). Impact of transport infrastructure on firm performance: Case study of Cuu long Delta area, Vietnam. *Problems and Perspectives in Management*, 17(2), 51-62.
- Wanjohi, F. M. (2020). Sustainable transportation practices and operational performance of multinational manufacturing firms in Nairobi County, Kenya. *Internal Journal of Logistics and Supply Chain Management*, 3(2), 87-98.