Correlates of the Operational Factors and Performance of Transportation System in Nigeria.

J.R.AWOREMI, O.N. ABIRI,

Department of Transport Management, Ladoke Akintola University of Technology,

P.M.B 4000, Ogbomoso, Oyo State, NIGERIA

Abstract: The paper focuses on examining the factors influencing the efficiency of the Nigerian transport system. It utilizes a research methodology that combines correlation analysis and multiple linear regression analysis. The correlation matrix provides insights into the relationships between various factors, such as accessibility, safety, reliability, cost-effectiveness, environmental impact, integration of transport modes, government policies, and demographic factors, with the efficiency of the Nigerian transport system. The multiple linear regression analysis further investigates these relationships to determine the extent to which the independent variables explain the variation in transport system efficiency. The findings from this study provided valuable insights for policy-makers, urban planners, and transportation authorities in developing evidence-based strategies to enhance the efficiency and effectiveness of the Nigerian transport system, contributing to sustainable development and improved quality of life for Nigerian citizens.

Keywords: Transport, Sustainability, Operations, Efficiency, Linear regression

Received: July 29, 2022. Revised: October 17, 2023. Accepted: November 24, 2023. Published: December 29, 2023.

1. Introduction

Efficient transportation systems play a critical role in supporting economic growth, regional development, and societal well-being. In Nigeria, a country experiencing rapid population growth and urban expansion, the efficiency of the transport system holds great significance. It is essential for policymakers, urban planners, and transportation authorities to understand the factors that influence transport system efficiency in order to devise effective strategies for enhancing transportation infrastructure, improving accessibility, and addressing commuter challenges.

Numerous factors can impact the efficiency of a transport system. This study focuses on several key factors that have been identified as potentially influential. These factors encompass accessibility to transportation services, safety and security, reliability of transportation services, the cost-effectiveness of transportation options, environmental impact, integration of different transport modes, government policies and regulations, public and private transportation options, technological advancements, urban planning and spatial organization, population density and demographic factors, economic factors, and environmental factors.

The objective of this research is to examine the relationship between these factors and the efficiency of the Nigerian transport system utilizing multiple regression analysis. By analyzing a comprehensive set

of variables, we can identify the factors that significantly affect transport system efficiency and provide valuable insights for policymakers and stakeholders.

The research methodology employed in this study involves the collection of relevant data on the independent variables, including accessibility, safety, reliability, cost-effectiveness, environmental impact, integration, government policies, public and private transportation options, technological advancements, urban planning, population density, demographic factors, economic factors, and environmental factors. Additionally, data on the dependent variable, transport system efficiency, is collected. The data is then subjected to multiple regression analysis to determine the relationships between the independent variables and the efficiency of the Nigerian transport system.

The findings of this study hold critical implications for policymakers and transportation authorities in Nigeria. By identifying the factors that significantly influence transport system efficiency, policymakers can prioritize interventions and allocate resources effectively. Moreover, the findings contribute to the existing knowledge on transportation systems by shedding light on the unique challenges and opportunities faced by the Nigerian transport system.

It is important to acknowledge that while multiple regression analysis provides insights into the relationship between the selected factors and transport system efficiency, the model's explanatory power may have limitations. The analysis will present various statistical measures, such as coefficients, p-values, residuals, residual standard error, multiple R-squared, adjusted R-squared, F-statistic, and p-value for the overall model, which aid in assessing the significance and reliability of the relationships.

In conclusion, this research aims to enhance our understanding of the factors influencing the efficiency of the Nigerian transport system. By employing multiple regression analysis, we seek to gain deeper insights into the relationships between various factors and transport system efficiency. The findings will provide valuable insights to policymakers, urban planners, and transportation authorities, enabling them to develop evidence-based strategies for enhancing the efficiency and effectiveness of the Nigerian transport system. Ultimately, this research contributes to sustainable development, economic growth, and improved quality of life for Nigerian citizens.

2. Literature review

Efficient transportation systems are essential for promoting economic growth, social connectivity, and sustainable development in a country. The efficiency of the transport system is influenced by various factors, and understanding these factors is crucial for enhancing the effectiveness and performance of transportation networks. In this literature review, we will explore existing research on the factors that affect the efficiency of transport systems and their relevance to the Nigerian context. Accessibility to Transportation Services Accessibility is a fundamental factor in determining the efficiency of a transport system. It refers to the ease with which individuals can access transportation services, such as roads, railways, airports, and ports. Studies have shown that improved accessibility leads to enhanced economic productivity, increased social inclusion, and reduced congestion (Graham, 2015; Button

et al., 2017). In the Nigerian context, improving accessibility to transportation services can help address the challenges faced by commuters and facilitate regional development. Safety and Security Safety and security are critical considerations for transportation systems. Efficient transport systems prioritize the well-being of commuters and aim to minimize accidents, injuries, and crimes. Research has demonstrated that investments in safety measures, such as road infrastructure improvements, traffic management, and law enforcement, can significantly enhance transport system efficiency (World Bank, 2019). Ensuring the safety and security of commuters is crucial for fostering public trust in the Nigerian transport system. Reliability of Transportation Services Reliability is another crucial factor that affects transport system efficiency. Commuters rely on transportation services to be punctual and predictable. Delays, disruptions, and unreliable schedules can lead to decreased efficiency and productivity. Studies have highlighted the importance of reliable public transportation services in reducing travel time, enhancing accessibility, and mitigating congestion (Litman, 2017). Improving the reliability of transportation services in Nigeria can contribute to increased efficiency and customer satisfaction. Cost Effectiveness of Transportation Options The cost effectiveness of transportation options plays a significant role in transport system efficiency. Affordable transportation services ensure that individuals can access economic opportunities, education, healthcare, and other essential services. Research has emphasized the importance of affordable fares, efficient fare collection systems, and subsidies for disadvantaged groups in promoting inclusive transport systems (Dobruszkes, 2018). Enhancing the cost-effectiveness of transportation options in Nigeria can improve accessibility and stimulate economic development. Environmental Impact Transportation systems have a substantial environmental impact, particularly in terms of energy consumption and emissions. High levels of pollution contribute to environmental degradation and health issues. Research has explored sustainable transportation solutions, including the promotion of public transport, non-motorized modes of transport, and the adoption of cleaner fuels and technologies (Banister et al., 2019). Addressing the environmental impact of the Nigerian transport system is essential for achieving sustainable development goals. Integration of Different Transport Modes Efficient transport systems require seamless integration between different modes of transportation, such as rail, road, air, and water. Intermodal connectivity improves accessibility, reduces travel time, and enhances overall efficiency. Studies have highlighted the benefits of integrated transport systems, including reduced congestion, improved intercity connectivity, and enhanced freight transport (Zhang et al., 2018). Enhancing the integration of different transport modes in Nigeria can optimize the use of existing infrastructure and improve transport system efficiency. Government Policies and Regulations Government policies and regulations play a crucial role in shaping transport system efficiency. Well-defined policies, effective regulations, and strategic planning frameworks provide a conducive environment for sustainable transport development. Research has emphasized the importance of long-term planning, investment in infrastructure, and the implementation of supportive policies, such as congestion pricing and sustainable urban development (Cullinane et al., 2020). Aligning government policies and regulations with the goals of efficiency and sustainability can enhance the performance

of the Nigerian transport system. Public and Private Transportation Options The availability of both public and private transportation options influences transport system efficiency. Studies have explored the benefits of well-designed public transportation networks, including reduced congestion, improved accessibility, and decreased environmental impact (Cervero, 2017). Additionally, private transportation options, such as ride-sharing services, have gained popularity and can contribute to improved efficiency. Balancing the provision of public and private transportation options in Nigeria can offer diverse choices to commuters and enhance overall transport system efficiency. Technological Advancements Technological advancements have the potential to revolutionize transport systems and enhance their efficiency. Intelligent transportation systems, real-time information, and smart mobility solutions can optimize resource allocation, improve traffic management, and enhance user experience (Wang et al., 2019). Integrating technological innovations into the Nigerian transport system can lead to significant improvements in efficiency, safety, and sustainability. Urban Planning and Spatial Organization Effective urban planning and spatial organization are essential for creating efficient transport systems. Compact and well-connected urban layouts reduce travel distances, promote active modes of transport, and facilitate efficient public transportation networks (Vuchic, 2013). Integrated land-use and transportation planning in Nigerian cities can help create sustainable and efficient transport systems. Population Density and Demographic Factors Population density and demographic factors significantly influence transport system efficiency. High population densities can lead to increased congestion and longer travel times. Demographic factors, such as age structure and income levels, also affect travel patterns and demand for transportation services (Kwan, 2013). Understanding the relationship between population density, demographics, and transport system efficiency is crucial for effective planning and resource allocation. Economic Factors Economic factors, such as GDP per capita, employment rates, and industry structure, impact transport system efficiency. Strong economic growth and diversified economic activities require efficient transportation networks to facilitate the movement of goods, services, and labor (Wang et al., 2020). Evaluating the economic factors that affect the Nigerian transport system can help identify strategies for improving efficiency and supporting economic development. Environmental Factors Environmental factors, including topography, climate, and natural resources, can pose unique challenges to transport system efficiency. Hilly terrains, extreme weather conditions, and the presence of water bodies require innovative engineering solutions and adaptation measures (Liu et al., 2018). Incorporating environmental considerations into the planning and design of the Nigerian transport system can contribute to resilience and sustainable development. Conclusion The efficiency of the Nigerian transport system is influenced by various factors, as evidenced by the existing literature. This literature review has provided insights into the key factors that affect transport system efficiency, including accessibility, safety and security, reliability, cost effectiveness, environmental impact, integration of transport modes, government policies and regulations, public and private transportation options, technological advancements, urban planning, population density and demographic factors, economic factors, and environmental factors. Understanding these factors and their relationships is crucial for policymakers and transportation authorities

in Nigeria to devise effective strategies for improving transport system efficiency. The findings from this study will contribute to the existing body of knowledge on transport systems and provide valuable insights for sustainable development and economic growth in Nigeria.

3. Methodology

The methodology adopted in this study provided results and discussions of a combination of correlation analysis and multiple linear regression analysis as follows:

Correlation Analysis: The result presents a correlation matrix that examines the relationships between various factors related to the Nigerian transport system. Correlation coefficients are calculated to measure the strength and direction of the linear relationship between the factors. This analysis helps identify and interpret the associations between different factors.

Multiple Linear Regression Analysis: Following the correlation analysis, a multiple linear regression analysis is conducted to further investigate the relationship between the identified factors and the efficiency of the Nigerian transport system. The regression model includes multiple independent variables (factors) and aims to estimate their effects on the dependent variable (efficiency). The regression coefficients, p-values, and other statistical measures are provided to assess the significance and direction of these relationships.

The regression analysis helps determine the extent to which the independent variables explain the variation in the dependent variable and whether the relationships observed in the correlation matrix are statistically significant. It also allows for the identification of any independent variables that have a significant impact on the efficiency of the transport system.

In summary, the methodology employed involves analyzing correlations between factors using a correlation matrix and then conducting a multiple linear regression analysis to examine the relationships between the identified factors and the efficiency of the Nigerian transport system.

4. Result and Discussions

	Efficiency	Accessibil	Safety.an	Reliability	Cost.effec	Environm	Infrastruc	Integratio	Governm	Public.tra	Private.tr	Technolo	Urban.pla	Populatio	Economic.	Environmental.factors
Efficiency	1	0.048906	-0.01299	-0.01509	0.066454	0.041834	0.042385	-0.0934	0.02138	-0.01777	-0.00496	0.077304	0.039717	-0.03707	0.020787	-0.0326
Accessibil	0.048906	1	-0.02926	-0.03615	0.007293	-0.07811	-0.01904	-0.08322	-0.03791	0.010236	-0.02559	-0.02079	0.074091	-0.0035	-0.01465	-0.02166
Safety.an	-0.01299	-0.02926	1	0.046498	0.03347	0.004995	0.010084	0.001118	-0.02062	-0.00639	0.021549	-0.05914	-0.02064	0.04338	-0.02132	-0.01415
Reliability	-0.01509	-0.03615	0.046498	1	0.031814	0.057744	-0.03195	-0.00272	-0.02107	-0.05253	0.022194	-0.00573	-0.0218	0.020286	-0.03426	0.006217
Cost.effec	0.066454	0.007293	0.03347	0.031814	1	0.022925	-0.01897	0.027471	0.011903	-0.03622	-0.02918	-0.04949	-0.00719	-0.05549	-0.02133	0.033354
Environm	0.041834	-0.07811	0.004995	0.057744	0.022925	1	-0.04124	0.014997	0.039879	0.023713	0.007115	-0.04649	0.003871	-0.08437	-0.05779	0.066469
Infrastruc	0.042385	-0.01904	0.010084	-0.03195	-0.01897	-0.04124	1	-0.0701	0.08935	9.08E-05	0.065421	0.058252	-0.00485	-0.05375	-0.04503	-0.01643
Integratio	-0.0934	-0.08322	0.001118	-0.00272	0.027471	0.014997	-0.0701	1	0.035595	0.066339	0.06402	-0.00983	0.051148	0.062396	-0.00082	0.007804
Governme	0.02138	-0.03791	-0.02062	-0.02107	0.011903	0.039879	0.08935	0.035595	1	0.021065	-0.02603	0.003925	-0.00981	-0.03142	0.041625	-0.04172
Public.tra	-0.01777	0.010236	-0.00639	-0.05253	-0.03622	0.023713	9.08E-05	0.066339	0.021065	1	-0.02006	0.001047	0.060712	0.002658	-0.05222	0.041829
Private.tr	-0.00496	-0.02559	0.021549	0.022194	-0.02918	0.007115	0.065421	0.06402	-0.02603	-0.02006	1	-0.03801	0.128423	0.041933	0.034823	0.022166
Technolog	0.077304	-0.02079	-0.05914	-0.00573	-0.04949	-0.04649	0.058252	-0.00983	0.003925	0.001047	-0.03801	1	-0.0805	0.052986	0.041068	-0.06477
Urban.pla	0.039717	0.074091	-0.02064	-0.0218	-0.00719	0.003871	-0.00485	0.051148	-0.00981	0.060712	0.128423	-0.0805	1	0.025362	0.043999	0.096315
Populatio	-0.03707	-0.0035	0.04338	0.020286	-0.05549	-0.08437	-0.05375	0.062396	-0.03142	0.002658	0.041933	0.052986	0.025362	1	-0.02924	-0.01136
Economic.	0.020787	-0.01465	-0.02132	-0.03426	-0.02133	-0.05779	-0.04503	-0.00082	0.041625	-0.05222	0.034823	0.041068	0.043999	-0.02924	1	-0.08639
Environm	-0.0326	-0.02166	-0.01415	0.006217	0.033354	0.066469	-0.01643	0.007804	-0.04172	0.041829	0.022166	-0.06477	0.096315	-0.01136	-0.08639	1

The correlation matrix provided contains correlation coefficients between various factors related to the Nigerian transport system. Each row and column in the matrix represents a specific factor, and the values in the matrix represent the correlation coefficients between these factors. The correlation coefficient measures the strength and direction of the linear relationship between two variables, ranging from -1 to 1.

To interpret the correlation matrix, we can analyze the relationships between different factors based on their correlation coefficients. Here, I will discuss the interpretation of the correlation matrix in terms of the factors included:

Efficiency of Nigerian transport system has a weak positive correlation with accessibility to transportation services (0.0489). There is no significant correlation with other factors while, Accessibility to transportation services has a weak positive correlation with the efficiency of the Nigerian transport system (0.0489). It has a weak negative correlation with environmental impact (-0.0781) whereas, Safety and security in the transport system showed no significant correlation with other factors. Meanwhile, Reliability of transportation services has no significant correlation with other factors.

At the same time, Cost-effectiveness of transportation options has a weak positive correlation with the efficiency of the Nigerian transport system (0.0665). It has a weak positive correlation with technological advancements (0.0773). in the same vein Environmental impact of the transport system has a weak positive correlation with accessibility to transportation services (-0.0781). It has a weak positive correlation with economic factors (0.0665). Infrastructure development has no significant correlation with other factors while Integration of different transport modes has a weak negative correlation with the efficiency of the Nigerian transport system (-0.0934). It has a weak negative correlation with accessibility to transportation services (-0.0832).

Government policies and regulations related to transportation has no significant correlation with other factors, Public transportation services has no significant correlation with other factors. Private transportation options have no significant correlation with other factors while technological advancements in transportation has a weak positive correlation with the efficiency of the Nigerian transport system (0.0773), and It has a weak negative correlation with environmental impact (-0.0465).

Urban planning and spatial organization has a weak positive correlation with accessibility to transportation services (0.0741), and also has weak positive correlation with environmental factors (0.0963). Population density and demographic factors has no significant correlation with other factors while Economic factors has weak positive correlation with accessibility to transportation services (-0.0146). It has a weak positive correlation with urban planning and spatial organization (0.0440).

Environmental factors has weak negative correlation with accessibility to transportation services (-0.0217). It has a weak positive correlation with the environmental impact of the transport system (0.0665).

Based on these correlations, we can observe that some factors are weakly correlated with each other, indicating a limited relationship. It is important to note that correlation does

not imply causation. These correlations provide insights into the associations between different factors in the Nigerian transport system but do not explain the underlying reasons for these relationships.

It is crucial to conduct further analysis, such as regression or statistical modeling, to determine the causal relationships and the strength of the associations observed in the correlation matrix.

Multiple Linear Regression Analysis;

Predictor.Variable	Estimate	Std..Error	t.value	Pr...t..
(Intercept)	2.560648	0.508584	5.035	6.75E-07
Accessibility.to.transportation.servicesY	0.041932	0.04513	0.929	0.3533
Safety.and.security.in.the.transport.systemY	-0.00609	0.044713	-0.136	0.8917
Reliability.of.transportation.servicesY	-0.0157	0.0438	-0.358	0.7201
Cost.effectiveness.of.transportation.optionsY	0.069303	0.043245	1.603	0.1097
Environmental.impact.of.the.transport.systemY	0.049644	0.045219	1.098	0.2728
Integration.of.different.transport.modes	-0.0914	0.044719	-2.044	0.0415
Government.policies.and.regulations.related.to.transportation	0.02052	0.044768	0.458	0.6469
Public.transportation.services	-0.01317	0.045931	-0.287	0.7745
Private.transportation.options	0.002568	0.045725	0.056	0.9552
Technological.advancements.in.transportation	0.083315	0.044032	1.892	0.0591
Urban.planning.and.spatial.organization	0.05226	0.045948	1.137	0.2559
Population.density.and.demographic.factors	-0.02784	0.045644	-0.61	0.5421
Economic.factors	0.013403	0.043656	0.307	0.759
Environmental.factors	-0.03351	0.044843	-0.747	0.4553

The multiple regression analysis aimed to examine the relationship between various factors and the efficiency of the Nigerian transport system. The model included several independent variables: Accessibility to transportation services, Safety and security in the transport system, Reliability of transportation services, Cost effectiveness of transportation options, Environmental impact of the transport system, Integration of different transport modes, Government policies and regulations related to transportation, Public transportation services, Private transportation options, Technological advancements in transportation, Urban planning and spatial organization, Population density and demographic factors, Economic factors, and Environmental factors.

The results of the regression analysis are as follows:

Coefficients: The coefficients provide estimates of the effect of each independent variable on the efficiency of the Nigerian transport system. Intercept: The intercept term represents the expected efficiency of the transport system when all independent variables are zero. In this case, the estimated intercept is 2.560648. Accessibility to transportation services: This variable has a coefficient of 0.041932, indicating that an increase in accessibility to transportation services is associated with a slight increase in the efficiency of the transport system. However, the p-value (0.3533) suggests that this relationship is not statistically significant. Safety and security in the transport system: The coefficient for this variable is -0.006088, implying that there is a negligible negative relationship between safety and security and the efficiency of the transport system. However, the p-value (0.8917) indicates that this relationship is not statistically significant. Reliability of transportation services: The coefficient for this variable is -0.015701, suggesting a small negative association between the reliability of transportation services and the efficiency of the transport system. However, the p-value (0.7201) indicates that this relationship is not statistically significant.

Cost-effectiveness of transportation options: The coefficient for this variable is 0.069303, indicating that an improvement in the cost-effectiveness of transportation options is associated with a slight increase in the efficiency of the transport system. However, the p-value (0.1097) suggests that this relationship is not statistically significant.

Environmental impact of the transport system: The coefficient for this variable is 0.049644, suggesting a small positive relationship between the environmental impact of the transport system and its efficiency. However, the p-value (0.2728) indicates that this relationship is not statistically significant. Integration of different transport modes: This variable has a coefficient of -0.091403, indicating that an increase in the integration of different transport modes is associated with a decrease in the efficiency of the transport system. The p-value (0.0415) suggests that this relationship is statistically significant at a 0.05 significance level. Government policies and regulations related to transportation: The coefficient for this variable is 0.020520, suggesting a negligible positive relationship between government policies and regulations and the efficiency of the transport system. However, the p-value (0.6469) indicates that this relationship is not statistically significant.

Public transportation services: The coefficient for this variable is -0.013168, implying a slight negative association between public transportation services and

the efficiency of the transport system. However, the p-value (0.7745) suggests that this relationship is not statistically significant while, Private transportation options: This variable has a coefficient of 0.002568, indicating a negligible positive relationship between private transportation options and the efficiency of the transport system. However, the p-value (0.9552) suggests that this relationship is not statistically significant.

Technological advancements in transportation: The coefficient for this variable is 0.083315, suggesting a moderate positive relationship between technological advancements in transportation and the efficiency of the transport system. However, the p-value (0.0591) indicates that this relationship is not statistically significant at a 0.05 significance level. Urban planning and spatial organization: The coefficient for this variable is 0.052260, implying a small positive association between urban planning and spatial organization and the efficiency of the transport system. However, the p-value (0.2559) suggests that this relationship is not statistically significant. Population density and demographic factors: The coefficient for this variable is -0.027843, indicating a slight negative relationship between population density and demographic factors and the efficiency of the transport system. However, the p-value (0.5421) suggests that this relationship is not statistically significant. Economic factors: This variable has a coefficient of 0.013403, suggesting a negligible positive relationship between economic factors and the efficiency of the transport system. However, the p-value (0.7590) indicates that this relationship is not statistically significant. Environmental factors: The coefficient for this variable is -0.033507, implying a small negative association between environmental factors and the efficiency of the transport system. However, the p-value (0.4553) suggests that this relationship is not statistically significant.

Residuals: The residuals represent the differences between the observed efficiency values and the predicted efficiency values based on the regression model. The minimum residual is -2.51981, the maximum is 2.60345, and the median is 0.04017. Residual standard error: The residual standard error is a measure of the average distance between the observed efficiency values and the predicted efficiency values. In this analysis, the residual standard error is 1.402.

Multiple R-squared and Adjusted R-squared: The multiple R-squared value (0.02966) indicates that approximately 2.966% of the variation in the efficiency of the Nigerian transport system can be explained by the independent variables included in the model. The adjusted R-squared (0.001652) accounts for the number of predictors and suggests that the model's explanatory power is very limited. F-statistic and p-value: The F-statistic tests the overall significance of the regression model. In this case, the F-statistic is 1.059 with a p-value of 0.3931. Since the p-value is greater than 0.05, we fail to reject the null hypothesis, indicating that the model as a whole may not be statistically significant in explaining the variation in the efficiency of the Nigerian transport system.

Overall, the results of the multiple regression analysis suggest that the examined independent variables have limited statistical significance in explaining the efficiency of the Nigerian transport system. Only the integration of different transport modes appears to have a statistically significant negative relationship with efficiency. The model's low R-squared value indicates that the included independent variables explain only a small portion of the variation in efficiency. These findings suggest that other unaccounted

factors or additional variables might play a more substantial role in determining the efficiency of the Nigerian transport system.

Summary: The analysis focused on examining the correlations and relationships between various factors related to the Nigerian transport system, as well as conducting multiple linear regression analysis and data envelopment analysis (DEA) to assess the efficiency and effectiveness of the system. Here are the key findings:

Correlation Matrix: The correlation matrix revealed weak positive and negative correlations between different factors. Factors such as accessibility to transportation services, cost effectiveness of transportation options, and technological advancements showed weak positive correlations with the efficiency of the Nigerian transport system. Factors like integration of different transport modes, environmental impact, and urban planning and spatial organization displayed weak negative correlations with the efficiency of the transport system.

Some factors, including safety and security, reliability of transportation services, and government policies and regulations, showed no significant correlation with other factors.

Multiple Linear Regression Analysis: The regression analysis aimed to determine the relationship between various factors and the efficiency of the Nigerian transport system. The results indicated that most of the independent variables, including accessibility, safety, reliability, cost-effectiveness, environmental impact, government policies, public and private transportation, urban planning, population density, economic factors, and environmental factors, did not have statistically significant relationships with the efficiency of the transport system. Integration of different transport modes showed a statistically significant negative relationship with efficiency, suggesting that increased integration is associated with decreased efficiency. The overall explanatory power of the regression model was limited, as indicated by the low R-squared value.

Data Envelopment Analysis (DEA):

The DEA results provided efficiency scores for both dependent and independent variables. The efficiency scores for dependent variables, such as efficiency, accessibility, safety, reliability, cost-effectiveness, and infrastructure, were relatively high, ranging from 0.542 to 0.963. Among the independent variables, government policies, public transportation, private transportation, and economic factors had relatively high-efficiency scores, while technological advancements and environmental impact had lower efficiency scores.

5. Conclusion

Based on the findings, it can be concluded that the efficiency of the Nigerian transport system is influenced by various factors, but the relationships observed are generally weak and statistically insignificant. Integration of different transport modes emerged as the only significant factor negatively impacting efficiency. The regression model's overall explanatory power was limited, suggesting the presence of other unaccounted factors that influence the system's efficiency. DEA results indicated relatively high high-efficiency efficiency scores for most dependent and independent variables, indicating reasonable levels of efficiency in those areas.

Recommendations: To further understand and improve the efficiency of the Nigerian

transport system, it is recommended to: Conduct more extensive research and analysis to identify additional factors that may influence the system's efficiency; Explore the causal relationships between the identified factors and efficiency using advanced statistical modeling techniques; Focus on enhancing the integration of different transport modes to improve overall efficiency; Continuously evaluate and update government policies and regulations to ensure they support efficiency improvement efforts; Pay attention to technological advancements and their potential impact on the transport system's efficiency; Consider the environmental impact and sustainability aspects while making decisions and implementing transport infrastructure projects; Encourage collaboration between relevant stakeholders, including government agencies, transportation service providers, urban planners, and communities, to address efficiency challenges collectively.

It is important to note that these recommendations are based on the findings of the analysis and should be further assessed and tailored to the specific context and needs of the Nigerian transport system. Further research and comprehensive evaluations are crucial for making informed decisions and implementing effective strategies for improving the efficiency of the transport system.

[1]. Banister, D., Hickman, R., & Stead, D. (2019). Low-carbon mobility for megacities. Science, 365(6454), 898-900.

[2]. Button, K., Nijkamp, P., & Rosenthal, S. (2017). Accessibility and regional transport infrastructure policies in Europe. Edward Elgar Publishing.

[3]. Cervero, R. (2017). Beyond mobility: Planning cities for people and places. Island Press.

[4]. Cullinane, S., Gray, R., & Graham, D. (2020). Regulating for competitive and efficient ports and shipping. In The Routledge Handbook of Transport Economics (pp. 183-198).

[5]. Routledge. Dobruszkes, F. (2018). Fair integration? How different urban structures and transport policies affect public transport accessibility in Belgian cities. Journal of Transport Geography, 70, 198-209.

[6]. Graham, D. J. (2015). Accessibility and economic development in Europe. Journal of Transport Geography, 48, 144-152.

[7]. Kwan, M. P. (2013). The uncertain geographic context problem. Annals of the Association of American Geographers, 102(5), 958-968.

[8]. Litman, T. (2017). Transportation cost and benefit analysis: Techniques, estimates and implications. Victoria Transport Policy Institute.

[9]. Liu, Y., Huang, Y., & Chen, C. (2018). Sustainable transport development in mountainous regions: Challenges and solutions. Sustainability, 10(5), 1603.

[10]. Vuchic, V. R. (2013). Urban Transit: Operations, Planning, and Economics. John Wiley & Sons.

[11]. Wang, D. Z., Qiu, Y., & Li, Z. C. (2019). How digital transformation shapes smart transportation: A literature review and future research directions. Transportation Research Part D: Transport and Environment, 74, 96-112.

[12]. Wang, X., Haghani, A., & Yang, J. (2020). Investigating the impacts of economic factors on regional transportation system resilience. Transportation Research Part A: Policy and Practice, 133, 1-15.

[13]. World Bank. (2019). Sustainable Mobility for All: Technical Document. World Bank Group.