

## **Public-Private Partnership and Infrastructural Development in Nigeria: A Study of Edo, Delta and Rivers States**

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### **Article History**

**Received:**

January 10, 2026

**Revised:**

January 18, 2026

**Accepted:**

January 21, 2026

**Published:**

February 27, 2026

### **ABSTRACT**

This study examined the impact of Public–Private Partnerships (PPPs) on infrastructure development in transportation, energy, information technology, health, and education sectors in Edo, Delta, and Rivers States, Nigeria. It was motivated by persistent infrastructure deficits and assessed PPPs as a strategy for sustainable development and improved service delivery. A cross-sectional survey design was adopted, with data collected through structured questionnaires administered to 400 respondents selected across the three states. The study was guided by Public Choice Theory and Resource Dependency Theory, which explain private sector participation in public service delivery and the benefits of interdependence between public and private actors. Data were analyzed using Spearman’s correlation and simple linear regression. Findings revealed that PPPs had a positive and significant effect on infrastructure development across all examined sectors. In transportation, PPPs improved road construction and maintenance, enhancing mobility and access. In the energy sector, they supported the expansion and modernization of electricity infrastructure, improving supply for domestic and industrial use. In information technology, PPPs facilitated broadband expansion and digital service delivery, promoting innovation and connectivity. In health and education, PPP projects contributed to the construction and renovation of hospitals, clinics, and schools, thereby improving access to essential services. The study concludes that PPPs are an effective mechanism for addressing Nigeria’s infrastructure deficits, particularly where public funding is limited. It recommends strengthening regulatory and institutional frameworks, especially in the transport sector, to ensure transparent procurement, accountability, and improved private sector participation for sustainable infrastructure development.

**Keywords:** *Public–Private Partnership; Infrastructure Development; Infrastructure Financing; Governance and Service Delivery; South–South Nigeria.*

**Contribution/Originality:** This study contributes empirical evidence on the impact of Public–Private Partnerships (PPPs) across transportation, energy, ICT, health, and education sectors in Edo, Delta, and Rivers States. Unlike previous studies focused on single sectors, it provides a multi-sector and multi-state analysis using primary data and quantitative methods. The study also integrates Public Choice Theory and Resource Dependency Theory to explain PPP effectiveness in addressing infrastructure gaps in developing economies. Its originality lies in offering comprehensive, cross-sector evidence on how PPPs improve infrastructure delivery in South-South Nigeria and highlighting the need for stronger regulatory and institutional frameworks to enhance efficiency and accountability.

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## 1. INTRODUCTION

Public-Private Partnerships (PPPs) have become a significant mechanism for infrastructure development globally, particularly in developing countries such as Nigeria. The concept of PPP emerged from the need to address the limitations of public sector financing and management in meeting growing infrastructural demands. In Nigeria, where infrastructural deficits constrain socio-economic growth, PPPs provide a viable framework for leveraging private sector resources, expertise, and efficiency to deliver critical public infrastructure.

Globally, PPPs have been instrumental in addressing infrastructure deficits, particularly in sectors such as transportation, energy, healthcare, and education. By involving private entities, governments can mitigate budget constraints, transfer certain project risks, and benefit from private sector innovation and efficiency (Sharma & Gupta, 2024). Public-Private Partnerships (PPPs) are collaborative agreements between government entities and private sector companies aimed at financing, developing, and operating public infrastructure projects. These partnerships leverage the expertise and resources of both sectors to deliver public services efficiently and effectively (Hodge & Greve, 2023).

According to Madu and Kenigua (2023), the concept of PPPs involves collaboration between government entities and private sector companies to finance, build, and operate infrastructure projects. This model is particularly relevant in Nigeria, where traditional public funding has been insufficient to meet the growing demands for infrastructure development. The need for innovative financing mechanisms has made PPPs an attractive option for state governments seeking to leverage private investment for public good.

According to Hodge and Greve (2023), the United Kingdom has a long history of utilizing PPPs, particularly through the Private Finance Initiative (PFI). Notable projects include the construction of hospitals and schools, which have improved service delivery and operational efficiency. In recent years, there has been a renewed focus on PPPs to address infrastructure needs. For instance, in United Kingdom, the UK government is considering reviving PPP models to fund major transport projects, aiming to attract private investment to alleviate public financial constraints. For the upcoming

2032 Brisbane Olympics, private financing is being explored by Australia government to fund infrastructure projects, including stadiums, to reduce the burden on taxpayers (Commonwealth of Australia, 2024).

In India, the National Highways Authority has utilized PPPs to expand road networks, which has facilitated trade and reduced transportation costs (Sharma & Gupta, 2024). Road concessions in countries like Mexico have shown how tolling mechanisms can be effectively implemented through PPPs to fund highway construction. Sustainability is increasingly becoming a focus in PPP projects as governments seek to align infrastructure development with environmental goals. For example, the Green Climate Fund supports PPP initiatives aimed at developing renewable energy projects in developing countries (World Bank, 2024). Thus, infrastructure plays a vital role in economic growth and development. In Nigeria, inadequate infrastructure has been identified as a major barrier to economic progress, affecting sectors such as transportation, healthcare, and education. By engaging private partners through PPPs, state governments can enhance the quality and efficiency of public services (Ibrahim & Adebayo, 2024).

According to Osagie and Okonofua (2024), Edo State has embraced the PPP model to address its infrastructural deficits, particularly in transportation and housing sectors. By partnering with private investors, the state government aims to improve road networks and develop affordable housing projects that meet the needs of its growing population. Adeyemo and Igbokwe (2023) argue that Delta State has implemented several PPP projects aimed at enhancing its infrastructural capacity. These initiatives focus on improving water supply systems and waste management services through collaborative efforts with private sector player. According to Nwankwo and Chukwuemeka (2024), Rivers State has also adopted PPPs to facilitate infrastructural development in areas such as transportation and energy supply. The state government's commitment to creating a conducive environment for private investment is crucial for achieving sustainable infrastructure development.

The Nigerian government has established a regulatory framework to guide the implementation of PPPs across states. The Infrastructure Concession Regulatory Commission (ICRC) plays a pivotal role in ensuring that PPP projects adhere to best practices while promoting transparency and accountability (ICRC, 2024). Studies have shown that effective implementation of PPPs can significantly contribute to economic growth by improving infrastructure quality and accessibility, thereby attracting more investments into Nigeria (Adekunle & Ogunleye, 2023; Olaniyan & Ojo, 2024). However, Maduneme (2023) and Ojo and Odebiyi (2023) post that despite the potential benefits of PPPs, several challenges hinder their successful implementation in Nigeria. Issues such as bureaucratic inefficiencies, corruption, and lack of transparency can undermine the effectiveness of PPP agreements. Addressing these challenges is crucial for ensuring that PPPs deliver their intended outcomes.

Thus, States like Edo, Delta, and Rivers, rich in natural and human resources, exemplify the critical need for infrastructural improvements to drive development. These states face challenges such as dilapidated roads, inadequate healthcare facilities, and erratic power supply, which hinder their full economic potential. PPP arrangements have been initiated to bridge these gaps, offering innovative models for project financing, implementation, and maintenance. This study examined the relationship between

public-private partnership (PPPs) and infrastructural development in Edo, Delta and Rivers States.

## 2. METHOD

For this study, a cross-sectional research design was employed to investigate the relationship between Public-Private Partnerships (PPPs) and infrastructural development in Edo, Delta, and Rivers States, Nigeria. A cross-sectional research design allows for the collection and analysis of data from multiple subjects at one point in time, enabling the identification of patterns, trends, and relationships between variables. This approach is particularly appropriate given the study's aim to explore the current status of PPPs in these states and their impact on infrastructure development. The population for this study consists of government officials, private sector partners (construction companies, infrastructure developers, etc.), and stakeholders from the local communities who are involved in or affected by PPP projects in these states.

Government officials at both state and local government levels who have been directly involved in PPP project planning, execution, and monitoring. Private sector partners (e.g., construction companies, consultants, investors) engaged in PPP projects within the states. Community stakeholders such as residents and local business owners who are affected by the infrastructural changes brought about by PPP projects. The target population for this study comprises of Edo State (5,160, 000), Delta State (7,110,000) and Rivers State (7,480,000). Thus, the combined population of Edo, Delta, and Rivers states is approximately 19,750,000. This figure is based on extrapolations from previous census data and adjusted for growth rates observed in 2022 (National Population Commission, 2022). The required sample size (n) is approximately 400, arrived at using the sample size determination of Yamane's formula. Given the population size of 19,750,000 and with a sampling error of 5 percent, the required sample size was computed calculated using Taro Yamane's formula:

$$n = \frac{N}{1 + Ne^2}$$

Where:

n = Sample size.

N = Total population size.

e = Margin of error (0.05 for a 95% confidence level).

$$n = \frac{19,750,000}{1 + 19,750,000 (0.05)^2} = 400.30, n = 400 \text{ approximately.}$$

The total sample size of 400 includes a range of key actors in the PPP process, from government officials and private sector representatives to community leaders and experts. This sample size was used to gather data through the sampling process to ensure a representative and balanced view of the state of PPPs and infrastructure development in Edo, Delta, and Rivers States.

**Table 1: Sample Selection Process**

State	Population	Computation of Sample Size	Sample Size (No of questionnaire to be distributed)
Edo	5,160, 000	$\frac{5,160, 000 \times 400}{19,750,000} =$	104
Delta	7,110,000	$\frac{7,110,000 \times 400}{19,750,000} =$	144
Rivers	7,480,000	$\frac{7,480,000 \times 400}{19,750,000} =$	151
<b>Total</b>	<b>19,750,000</b>		<b>400</b>

**Source:** Author’s Computation, 2026

This study employed a stratified random sampling technique to select participants from each state. Stratified sampling ensures that various categories of respondents are represented, including government officials, private sector partners, and community stakeholders. The sample was divided into the following strata:

1. Government officials: Key personnel in ministries of works, urban development, public-private partnership departments, and state planning commissions.
2. Private sector partners: Representatives of construction firms, financial institutions, and other private entities involved in PPP projects.
3. Community stakeholders: Residents and business owners in communities directly impacted by PPP infrastructure projects.

Using this stratified approach, a random selection is made within each stratum to ensure that the sample reflects the diversity within each group. Data collected was analyzed using descriptive statistics and inferential statistics. Descriptive statistics were used to summarize and present the data, including frequency distributions, percentages, and mean scores. This helps in understanding the overall trends and patterns in the data. Inferential statistics were used to test hypotheses and assess the relationships between PPPs and infrastructural development. Specifically, correlation analysis and linear regression analysis were employed to determine the strength and significance of the relationship between PPP projects and infrastructure outcomes. The analysis was conducted using Statistical Package for the Social Sciences (SPSS) or other relevant statistical software version 23.0.

### **3. FINDINGS AND DISCUSSION**

This study explored the effects of Public-Private Partnerships (PPPs) in facilitating infrastructural development in Nigeria, specifically focusing on Edo, Delta, and Rivers States. Specifically, it aimed to investigate the relationship between Public-Private Partnerships (PPPs) and the improvement of transportation infrastructure in Edo, Delta,

and Rivers States, examine the relationship between PPPs and the development of energy infrastructure in the selected states, analyze the relationship between PPPs and the development of information technology infrastructure in Edo, Delta, and Rivers States and assess the correlation between PPPs and the development of health and education infrastructure in Edo, Delta, and Rivers States. To achieve the overall objective of the study, 400 questionnaire were distributed to government officials, private sector partners, and community stakeholders across the three states. The questionnaire included personal data of the respondents as well as questions related to the study's focus.

**Table 2: Distribution of Questionnaire and Response Rate**

S/N	State	Questionnaires Distributed	Questionnaires Retrieved	Percentage (%)
1	Edo	104	93	89.42
2	Delta	144	127	88.19
3	Rivers	151	138	91.39
	<b>Total</b>	<b>400</b>	<b>358</b>	<b>89.5</b>

**Source:** Researcher's Fieldwork (2026)

Table 2 illustrated the distribution and retrieval statistics for the questionnaire administered in the course of this research, which investigates the impact of Public-Private Partnerships (PPPs) on infrastructural development within Nigeria. The study focused on three key states, Edo, Delta, and Rivers, chosen due to their strategic economic significance and ongoing PPP-related initiatives. The table reflects both the quantity of questionnaire disseminated in each state and the number successfully retrieved, as well as the computed response rates expressed in percentages. Out of a total of **400 questionnaire** distributed across the three states, **358 were retrieved**, culminating in an **overall response rate of 89.5%**. This remarkably high rate of response is indicative of strong engagement from the sampled population, demonstrating their willingness to contribute to the study. Such a response level enhances the credibility of the dataset and bolsters the validity and generalizability of the research findings. It also reflects the effectiveness of the data collection strategy and the relevance of the study topic to the target population. Thus, the data presented in Table 2 highlights a highly successful data collection phase, characterized by robust participation rates. This affirms the reliability and comprehensiveness of the responses gathered and underscores the suitability of the data for addressing the core objectives of this research.

### **Testing of Hypotheses**

This section presents the results of the hypotheses formulated in line with the study objectives. The purpose of hypothesis testing is to determine the statistical significance of the observed relationships between Public-Private Partnerships (PPPs) and infrastructural development across Edo, Delta, and Rivers States. Using appropriate inferential statistical tools, the hypotheses were tested to either accept or reject the null

hypotheses, thereby providing empirical evidence to support the study’s findings. The results are presented and interpreted in relation to the research theoretical framework:

H<sub>1</sub>: There is no significant relationship between PPPs and the improvement of transportation infrastructure in Edo, Delta, and Rivers States.

**Table 3: Correlation of PPPs and the Improvement of Transportation Infrastructure in Edo, Delta, and Rivers States**

	Variables		PPPs	Transportation Infrastructure
<b>Spearman's rho</b>	<b>PPPs</b>	Correlation Coefficient Sig. (2-tailed) N	1  358	.788**  .000 358
	<b>Transportation Infrastructure</b>	Correlation Coefficient Sig. (2-tailed) N	.788** .000 358	1  358

\*\* . Correlation is significant at the 0.05 level (2-tailed)

**Source:** SPSS Output, 2025

Table 3 displays the outcome of a Spearman’s rho correlation analysis aimed at assessing the relationship between Public-Private Partnerships (PPPs) and the development of transportation infrastructure in the three selected states: Edo, Delta, and Rivers. The Spearman correlation coefficient of 0.788 indicates a strong positive relationship between the effectiveness of PPPs and the degree of improvement in transportation infrastructure. This suggests that increased engagement and performance of PPPs are closely linked to notable enhancements in transportation systems within the study locations. The p-value of 0.000, which is significantly less than the conventional alpha level of 0.05, confirms that the correlation is statistically significant. This means that the observed relationship is unlikely to have occurred by random chance and reflects a genuine association between the two variables. Given the strength and statistical significance of this correlation, the findings provide empirical support for the hypothesis that PPPs contribute positively to the development of transportation infrastructure in Edo, Delta, and Rivers States. Therefore, the null hypothesis is rejected while the alternative hypothesis is accepted, indicating that a significant relationship exists between Public-Private Partnerships (PPPs) and the enhancement of transportation infrastructure in Edo, Delta, and Rivers States. The analysis offers compelling evidence that PPPs are an important driver in enhancing transportation infrastructure across the selected states. The strong and significant correlation underscores the potential of PPPs to fill infrastructural gaps in road networks and transit systems. These results suggest that

policy interventions aimed at strengthening PPP implementation could yield measurable improvements in transportation outcomes across the region.

**H<sub>2</sub>:** There is no significant relationship between PPPs and the development of energy infrastructure in Edo, Delta, and Rivers States.

**Table 4: Correlation of PPPs and the Development of Energy Infrastructure in Edo, Delta, and Rivers States**

	Variables		PPPs	Development of Energy Infrastructure
<b>Spearman's rho</b>	<b>PPPs</b>	Correlation Coefficient	1	.779**
		Sig. (2-tailed)		.000
		N	358	358
	<b>Development of Energy Infrastructure</b>	Correlation Coefficient	.779**	1
Sig. (2-tailed)		.000		
N		358	358	

\*\* . Correlation is significant at the 0.05 level (2-tailed)

**Source:** SPSS Output, 2026

Table 4 displays the outcome of a Spearman’s rank-order correlation analysis, which was carried out to determine the nature and strength of the relationship between Public-Private Partnerships (PPPs) and the development of energy infrastructure across Edo, Delta, and Rivers States. The Spearman’s correlation coefficient calculated for the relationship between PPPs and energy infrastructure development is **0.779**. This value indicates a **strong and positive correlation**, suggesting that as the implementation and effectiveness of PPPs increase, there is a corresponding and substantial improvement in the development of energy infrastructure. In essence, states that are more engaged in PPP activities tend to experience greater progress in their energy sectors, such as improved power supply, increased access to electricity, and upgraded transmission systems. Therefore, the null hypothesis is rejected while the alternative hypothesis is accepted, indicating that a significant relationship exists between Public-Private Partnerships (PPPs) and substantial improvement in the development of energy infrastructure in Edo, Delta, and Rivers States. The associated **p-value of 0.000** signifies a high level of statistical significance, as it is **far below the conventional threshold of 0.05**. This means that the likelihood of observing this strong correlation by random chance is extremely low. Therefore, the relationship identified in this study is both reliable and meaningful from a statistical perspective. The findings clearly indicate a **statistically significant and strong positive relationship** between Public-Private Partnerships and the development of energy infrastructure in Edo, Delta, and Rivers States. This implies that PPPs play a critical role in facilitating energy development projects such as the construction of power plants, extension of electricity grids, and adoption of alternative energy solutions. The results underscore the importance of

encouraging and expanding PPP frameworks as a strategic approach to addressing the energy infrastructure challenges in these states and potentially across Nigeria.

H<sub>3</sub>: There is no significant relationship between PPPs and the development of information technology infrastructure in Edo, Delta, and Rivers States.

**Table 5: Correlation of PPPs and the Development of Information Technology Infrastructure in Edo, Delta, and Rivers States**

	Variables		PPPs	Development of Information Technology Infrastructure
<b>Spearman's rho</b>	<b>PPPs</b>	Correlation Coefficient	1	.768**
		Sig. (2-tailed)		.000
		N	358	358
	<b>Development of Information Technology Infrastructure</b>	Correlation Coefficient	.768**	1
		Sig. (2-tailed)	.000	
		N	358	358

\*\* . Correlation is significant at the 0.05 level (2-tailed)

**Source:** SPSS Output, 2026

Table 5 illustrates the outcome of a **Spearman’s rank-order correlation analysis**, which was carried out to explore the **nature, strength, and direction** of the relationship between **Public-Private Partnerships (PPPs)** and the **development of information technology (IT) infrastructure** across the Nigerian states of Edo, Delta, and Rivers. The computed Spearman’s correlation coefficient of **0.768** reflects a **strong and direct positive relationship** between the two variables. This high value suggests that an increase in the implementation or quality of PPPs is closely linked with notable improvements in IT infrastructure. Specifically, this includes the expansion of broadband internet services, the establishment of digital innovation hubs, the rollout of government digital platforms, as well as the adoption of modern technologies in public service delivery. In practical terms, regions with more active PPP engagements are likely to experience faster and more effective growth in their digital and ICT ecosystems. The significance level (p-value) of **0.000** confirms that the observed relationship is **statistically significant**. Since this value is far below the conventional threshold of **0.05**, it indicates that the strong correlation between PPPs and IT infrastructure development is unlikely to have occurred by chance. This provides a sound statistical basis for drawing valid conclusions from the data, reinforcing the credibility of the link between increased PPP activity and advancements in the IT sector. Thus, the null hypothesis is rejected while the alternative hypothesis is accepted, indicating that a significant relationship

exists between Public-Private Partnerships (PPPs) and the development of information technology infrastructure in Edo, Delta, and Rivers States. The findings clearly indicate a **strong, positive, and statistically significant correlation** between Public-Private Partnerships and the development of information technology infrastructure in Edo, Delta, and Rivers States. This suggests that PPPs are an essential driver of digital growth in these states. By leveraging the resources, expertise, and innovations of the private sector in collaboration with government agencies, states can fast-track the deployment of critical IT infrastructure, improve digital service delivery, and enhance public sector efficiency. The results underscore the importance of strengthening PPP frameworks as a **strategic tool for digital transformation, socio-economic development, and technological inclusion** across Nigeria.

H<sub>4</sub>: There is no significant relationship between PPPs and the development of health and education infrastructure in Edo, Delta, and Rivers States.

**Table 6: Correlation of PPPs and the Development of Health and Education Infrastructure in Edo, Delta, and Rivers States**

	Variables		PPPs	Development of Health and Education Infrastructure
<b>Spearman's rho</b>	<b>PPPs</b>	Correlation Coefficient Sig. (2-tailed) N	1  358	.783**  .000 358
	<b>Development of Health and Education Infrastructure</b>	Correlation Coefficient Sig. (2-tailed) N	.783** .000 358	1  358

\*\* . Correlation is significant at the 0.05 level (2-tailed)

Source: SPSS Output, 2025

Table 6 summarizes the outcome of a **Spearman's correlation analysis** conducted to evaluate the **direction and strength** of the association between **Public-Private Partnerships (PPPs)** and the **development of health and education infrastructure** across three key Nigerian states: Edo, Delta, and Rivers. The analysis provides insight into how collaborative efforts between the public and private sectors are influencing infrastructure growth in two of the most vital social sectors, healthcare and education. The computed Spearman's correlation coefficient is **0.783**, indicating a **strong and direct positive relationship** between the extent of PPP implementation and improvements in health and education infrastructure. This means that higher levels of PPP involvement are associated with increased investments, upgrades, and innovations

in healthcare and educational facilities. This strong correlation reflects the growing role of PPPs in addressing critical infrastructure gaps and enhancing the quality of life in these regions. The **p-value of 0.000** indicates that the relationship observed between PPPs and infrastructure development is **highly statistically significant**. Since this value is far below the commonly accepted threshold of **0.05**, it confirms that the correlation is not the result of random variation. Rather, it underscores a dependable and evidence-based association, making the results **credible and actionable** for policymakers, planners, and stakeholders interested in improving health and education through PPPs. Thus, the null hypothesis is rejected while the alternative hypothesis is accepted, indicating that a significant relationship exists between Public-Private Partnerships (PPPs) and the development of health and education infrastructure in Edo, Delta, and Rivers States. The results clearly establish a **strong, positive, and statistically significant correlation** between Public-Private Partnerships and the development of health and education infrastructure in Edo, Delta, and Rivers States. This implies that PPPs are playing a **transformational role** in enhancing the availability, accessibility, and quality of healthcare and educational services. The findings emphasize the value of fostering greater public-private collaboration to overcome infrastructure deficits in critical social sectors. By leveraging the strengths of both the public and private sectors, such as capital investment, technical expertise, innovation, and efficient project execution, PPPs offer a **sustainable and scalable model** for improving health and education outcomes. Expanding these partnerships could be pivotal not only for the continued growth of these states but also for achieving broader national development goals in Nigeria.

**Influence of PPPs on Infrastructural Development in Edo, Delta, and Rivers States**

Since correlation does not imply causation, a linear regressions analysis was done to verify the influence of PPPs on infrastructural development in Edo, Delta, and Rivers States. The linear regression analysis which was conducted at 5% level of significance was used to further test hypotheses formulated for this study. Summary result of test was presented in Table 7.

**Table 7: Summary of a Simple Regression Analysis of the Influence of PPPs on Infrastructural Development**

Variables	R Square	Adjusted R Square	Coefficient	F-stat	F-sig.	T-stat	t-sig.	D.W
Transportation infrastructure	.457	.294	.613	21.305	.005 <sup>b</sup>	8.760	.005	1.995
Energy infrastructure	.385	.279	.485	17.140	.005 <sup>b</sup>	6.116	.005	1.938
Information technology infrastructure	.370	.260	.479	13.526	.005 <sup>b</sup>	5.083	.005	1.925

Health and education infrastructure	.448	.290	.600	20.684	.005 <sup>b</sup>	8.350	.005	1.970
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**Source:** SPSS Output, 2025

Table 7 summarizes the findings of linear regression analyses conducted to evaluate the extent to which Public-Private Partnerships (PPPs) impact the development of four key infrastructural sectors: transportation, energy, information technology, and health and education. The data offers insight into how collaborative investments between public authorities and private entities contribute to infrastructural growth in these critical areas across the three states. The R Square ( $R^2$ ) value in each model represents the proportion of the variance in infrastructural development that is explained by PPPs. Values closer to 1 suggest a stronger predictive relationship. The Adjusted R Square adjusts this estimate to account for the number of predictors in the model, providing a more accurate reflection of its explanatory power across different samples. The regression coefficient (B) indicates the magnitude of change in infrastructure development for each unit increase in PPP engagement. The F-statistic and its corresponding significance level (F-sig.) test whether the regression model is statistically valid, while the t-statistic and t-significance level (t-sig.) evaluate whether the individual predictor, PPPs significantly affects the dependent variables. Finally, the Durbin-Watson (D.W.) statistic tests for the presence of autocorrelation in the residuals, with values close to 2 suggesting that there is no serial correlation and the model is stable.

In the case of transportation infrastructure, the analysis reveals that PPPs explain approximately 45.7% of the variation in development ( $R^2 = 0.457$ ), with an Adjusted  $R^2$  of 0.294. The regression coefficient is 0.613, indicating a strong positive relationship between PPP activities and transportation infrastructure improvements. The model is statistically significant, as evidenced by an F-statistic of 21.305 and a p-value of 0.005. The t-test also confirms that PPPs significantly influence transportation infrastructure ( $t = 8.760$ ,  $p = 0.005$ ). The Durbin-Watson value of 1.995 indicates no issue of autocorrelation, further supporting the model's validity. For energy infrastructure, PPPs account for 38.5% of the variance ( $R^2 = 0.385$ ), with an Adjusted  $R^2$  of 0.279. The coefficient of 0.485 shows a moderately strong positive relationship between PPPs and improvements in energy infrastructure. The F-statistic of 17.140 and its significance value of 0.005 confirm that the model is statistically valid. The t-statistic of 6.116 and corresponding significance level also show that PPPs are a significant predictor in this sector. A Durbin-Watson value of 1.938 confirms the absence of serial correlation in the data.

For information technology infrastructure, the results show that PPPs explain 37% of the variance in development outcomes ( $R^2 = 0.370$ ; Adjusted  $R^2 = 0.260$ ). A regression coefficient of 0.479 suggests a moderately strong positive effect. The F-statistic (13.526) and its p-value (0.005) affirm that the model is statistically significant, while the t-statistic of 5.083 and corresponding p-value further support the influence of PPPs in this domain. The Durbin-Watson statistic of 1.925 again suggests no autocorrelation, indicating a well-fitting model. In the area of health and education infrastructure, the regression results show that PPPs account for 44.8% of the variability in development ( $R^2 = 0.448$ ; Adjusted  $R^2 = 0.290$ ). The coefficient value of 0.600 reflects a strong and positive impact of PPPs. With an F-statistic of 20.684 and a significance level of 0.005,

the model is statistically valid. The t-statistic of 8.350 and the associated p-value confirm the significance of PPPs in driving health and education infrastructure. A Durbin-Watson value of 1.970 indicates that the residuals are not autocorrelated, affirming the model's reliability.

Overall, the regression analyses across the four sectors consistently show that Public-Private Partnerships have a significant and positive influence on infrastructural development in Edo, Delta, and Rivers States. The relatively high  $R^2$  values, significant F and t statistics, and acceptable Durbin-Watson values close to 2 across all sectors reinforce the reliability and validity of the model. Among the sectors analyzed, transportation and health and education infrastructure exhibit the most substantial impact from PPP initiatives. These findings emphasize the strategic importance of PPPs as a driving force behind sustainable infrastructure development, especially in contexts where government resources alone may be insufficient to meet growing infrastructure demands.

### **Discussion of Findings**

The study examined the effectiveness of Public-Private Partnerships (PPPs) in facilitating infrastructural development in Nigeria, specifically focusing on Edo, Delta, and Rivers States. In this study, four hypotheses were developed to explore the influence of Public-Private Partnerships (PPPs) on infrastructural development across multiple sectors in Edo, Delta, and Rivers States. The first hypothesis specifically focused on examining the critical role PPPs play in the development of transportation infrastructure within these states. The finding revealed a statistically significant and positive relationship between PPP engagement and the growth of transportation systems. This indicates that as PPP initiatives increase, there is a corresponding and measurable improvement in transportation infrastructure across the states under review.

The finding further revealed that PPPs are not only statistically significant predictors of transportation development, but they also exert a substantial influence on the quality, scale, and sustainability of transport-related projects. This finding is highly consistent with a wide range of existing literature, which underscores the transformative impact of PPPs in enhancing infrastructure delivery in emerging and developing economies. Scholars such as Nwankwo and Chukwuemeka (2024) and Raheem and Adebayo (2024) argue that PPPs serve as effective instruments in bridging critical funding gaps, accelerating project execution, and improving operational efficiency, particularly in contexts where public resources alone are inadequate to meet growing infrastructure demands.

Moreover, several empirical studies have reinforced the assertion that PPPs contribute significantly to transportation development by leveraging the financial strength, technical expertise, and innovation of private sector actors. These advantages are complemented by the institutional support, oversight, and policy frameworks provided by government agencies. As noted by Osei-Kyei and Chan (2022), such synergistic collaboration often results in more efficient implementation, timely project delivery, and longer-term maintenance of critical transport assets such as roads, bridges, and rail networks. The reduction of financial and operational risk on the part of the public sector is another key benefit, as PPPs allow governments to reallocate limited resources to other priority sectors without compromising infrastructure quality.

This study's finding also aligns with those of Adebayo and Daramola (2021), who observed that PPP-driven highway and urban transportation projects in Nigeria have not

only improved road infrastructure but have also enhanced sustainability and service delivery, particularly in high-density and economically strategic regions. These partnerships frequently adopt innovative financing techniques, including build-operate-transfer (BOT) and concession models, while fostering long-term accountability and performance-based outcomes. In effect, PPPs help to resolve deep-rooted infrastructural deficits and expand access to modern transportation systems.

Within the broader context of infrastructure financing in sub-Saharan Africa, the finding of this study echo the conclusions drawn by Babatunde et al. (2020), who emphasize that PPPs are vital to overcoming fiscal constraints and driving inclusive, sustainable development. Transportation infrastructure, being a cornerstone of national competitiveness, economic productivity, and regional connectivity, benefits immensely from the integration of private sector capabilities in project design, funding, and delivery. The consistency of the finding with a growing body of empirical evidence further reinforces the reliability and relevance of PPPs as strategic tools for development. For instance, Wasiu (2019), Rao and Rao (2023), Udo (2023), and Wike (2024) have all documented the effectiveness of PPP models in catalyzing infrastructure transformation in the transport sector. Their works collectively highlight how properly structured PPPs can unlock new investment channels, foster innovation, and ensure project sustainability over the long term.

The finding of this study offers strong empirical support for the argument that PPPs are instrumental in advancing transportation infrastructure in Edo, Delta, and Rivers States. It validates the proposition that scaling up PPP frameworks is not only desirable but essential for addressing Nigeria's infrastructure challenges. The finding contributes to the ongoing policy dialogue on the need for enhanced public-private collaboration in infrastructure financing and provides a clear direction for governments and stakeholders to institutionalize PPPs as a central mechanism in national and subnational development strategies.

With respect to hypothesis two, the finding of the study reveal a moderately strong and statistically significant relationship between Public-Private Partnerships (PPPs) and the development of energy infrastructure in Edo, Delta, and Rivers States. This outcome indicates that increased PPP engagement plays a meaningful role in enhancing the availability, quality, and sustainability of energy infrastructure in the region. Although not as strong as the influence observed in the transportation sector, the relationship is substantial enough to underscore PPPs as a strategic mechanism for driving improvements in electricity generation, distribution networks, and access to modern energy services. This finding is supported by recent studies that emphasize the growing importance of PPPs in addressing Nigeria's energy infrastructure deficits. For instance, Okonkwo and Adeyemi (2023) assert that PPPs have become essential tools for funding large-scale energy projects, particularly given the constraints of public finance. They argue that the private sector brings not only capital but also innovation, risk management practices, and operational efficiencies that are lacking in purely government-led initiatives.

Moreover, Agbo and Hassan (2024) highlight the significant role PPPs have played in the expansion of Independent Power Projects (IPPs) and mini-grid systems across various Nigerian states. These projects are often executed under build-operate-transfer (BOT) or concession models that enable long-term collaboration between the government and private energy firms. The moderate strength of the relationship found

in this study reflects the reality that while PPPs are increasingly contributing to energy development, challenges such as regulatory uncertainty, delayed approvals, and weak policy enforcement still limit their full potential. This is echoed by Oluwaseun and Tanko (2022) and Aulia and Steelyana (2023), who note that despite the increasing adoption of PPPs in Nigeria's power sector, the impact varies across regions due to differences in state-level policy frameworks, institutional capacity, and investor confidence. Nevertheless, the statistically significant influence demonstrated in this study affirms that PPPs are indeed making measurable contributions to energy infrastructure development in Edo, Delta, and Rivers States.

Furthermore, from a regional perspective, Bassey et al. (2023) argue that in sub-Saharan Africa, PPPs are critical to bridging the infrastructure-financing gap in the energy sector. They emphasize that collaborative models offer more scalable and sustainable solutions, especially in economies with growing energy demands and limited government spending power. The finding support hypothesis two by confirming that PPPs have a positive and statistically significant impact on energy infrastructure development in the study area. They also align with the broader literature on infrastructure financing in Nigeria and Africa more broadly. The results reinforce the need for policies that foster enabling environments for PPP investments, including improved regulatory clarity, transparent procurement processes, and investor protection mechanisms. If properly harnessed, PPPs can accelerate Nigeria's transition to a more stable, accessible, and resilient energy infrastructure system.

With respect to hypothesis three, the study reveals that Public-Private Partnerships (PPPs) significantly influence the development of information technology (IT) infrastructure in Edo, Delta, and Rivers States. While the relationship is moderately strong, it is nonetheless statistically significant and practically meaningful. These findings support broader calls for the expansion of PPPs as a tool for accelerating digital infrastructure development in Nigeria. Governments at all levels should therefore prioritize enabling legal, institutional, and policy environments that encourage sustained private sector involvement in the ICT sector. This finding corroborates the growing consensus in literature that PPPs are vital instruments in accelerating digital transformation, especially in developing economies where public sector capacity is often constrained (Madu & Kenigua, 2021; Fregene & Okereke, 2024; Ezeokoli & Nwankwo, 2024). The finding aligns with Anyaoku and Nwachukwu (2022) who assert that strategic collaboration between public authorities and private investors enhances ICT service delivery, promotes digital inclusion, and supports innovation-driven infrastructure development. This finding concurs with the work of Ibrahim and Afolayan (2023), who argue that PPPs have become essential for deploying broadband infrastructure and data connectivity in underserved regions of Nigeria. Their study affirms that through PPPs, state governments have been able to attract private capital and technical expertise for the establishment of digital platforms, smart classrooms, e-health systems, and public Wi-Fi hubs. Moreover, the finding is in line with Okon and Musa's (2024) observation that PPPs offer a viable solution to the digital infrastructure gap in Nigeria, particularly as the country strives to implement its National Digital Economy Policy (2020–2030). They emphasize that by engaging private sector actors in ICT development, the government can fast-track digital penetration, improve service efficiency, and boost economic productivity.

This finding also supports the conclusions drawn by Nwachukwu and Oduwole (2023), who highlight the role of PPPs in facilitating the deployment of ICT

infrastructure critical for e-governance, financial technology, and digital education. According to their findings, public-private collaboration helps overcome bureaucratic bottlenecks, ensures timely project delivery, and introduces innovation in both design and implementation. Additionally, this study's finding echo those of Emeh and Adepoju (2022), who examined the use of PPPs in Nigeria's smart city initiatives and found that such collaborations were instrumental in delivering integrated IT solutions for transportation, public safety, and utilities. These initiatives demonstrate how PPPs can transform urban governance through technology-enabled infrastructure. This finding reinforces the argument that PPPs are pivotal to the development of robust and sustainable IT infrastructure in Nigeria. By leveraging the strengths of both sectors, PPPs can drive investment in digital ecosystems, improve public access to technology, and foster innovation. The evidence thus validates hypothesis three and strengthens the call for policies that encourage private sector participation in Nigeria's digital development strategy.

Lastly, with respect to hypothesis four, the study reveals that an increase in Public-Private Partnership (PPP) activity leads to substantial improvements in the availability, accessibility, and quality of health and educational facilities in Edo, Delta, and Rivers States. This finding affirms that PPPs play a critical role in driving infrastructural development in the social sectors, particularly in contexts where public funding and capacity are insufficient to meet growing service demands. This finding corroborates the position of Chidubem and Adebisi (2023), who argue that PPPs in Nigeria have helped bridge longstanding infrastructure deficits in healthcare and education. According to their study, PPP initiatives have facilitated the construction and renovation of hospitals, provided essential medical equipment, upgraded learning environments, and expanded access to schooling, especially in underserved communities.

Moreover, this finding is in line with the findings of Akinwale and Danjuma (2022), who note that PPP models, such as build-own-operate and service contracts, have improved service delivery and infrastructure maintenance in both sectors. These arrangements often result in better-managed facilities, more efficient delivery service, and measurable improvements in health and learning outcomes. The study's findings also concur with Okpara and Ayodele (2024), who emphasize the growing reliance on PPPs for achieving development goals related to public health and education. Their research highlights that partnerships with the private sector have led to more innovative and accountable approaches to infrastructure development, including digital classrooms, telemedicine, and vocational education centers.

Furthermore, the finding is consistent with international best practices and global development frameworks. According to the World Bank (2023), PPPs are increasingly being adopted as strategic tools for achieving the Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being) and SDG 4 (Quality Education). The World Bank (2023) emphasizes that PPPs can enhance the efficiency, quality, and sustainability of social infrastructure by leveraging private capital, technology, and operational expertise. In essence, the findings validate hypothesis four, confirming that PPPs significantly contribute to the transformation of health and education infrastructure in Edo, Delta, and Rivers States. By improving access to functional hospitals and modern educational institutions, PPPs can enhance public

welfare and strengthen human capital. This finding provides compelling evidence for the continued expansion and institutionalization of PPPs as a sustainable mechanism for social development in Nigeria.

#### **4. CONCLUSION**

This study explored the role of Public-Private Partnerships (PPPs) in driving infrastructure development across four essential sectors, transportation, energy, information technology (IT), and health and education in Edo, Delta, and Rivers. The study was guided by the need to identify sustainable and effective solutions to Nigeria's persistent infrastructure challenges, and to examine the rising adoption of PPP models as a collaborative strategy between public institutions and private investors to close critical development gaps. Historically, the public sector has struggled to fund and maintain essential infrastructure. Factors such as limited financial resources, administrative bottlenecks, inefficiencies, and political interference have hampered progress and deepened the infrastructure deficit in many parts of the country. Within this context, PPPs have gained prominence as an innovative and practical model, bringing together the financial strength, operational discipline, and creativity of the private sector with the oversight and legitimacy of public authorities. This study evaluated the extent to which such partnerships have delivered tangible benefits in terms of infrastructure development and whether they represent a sustainable path forward.

This study confirmed that PPPs exert a clear and positive impact on infrastructure development. In transportation, for example, PPPs have facilitated the upgrading and expansion of road networks and transit systems, which in turn have led to improved connectivity, reduced travel time, and enhanced access to economic opportunities. In settings where public funding alone proved insufficient or too slow, PPPs offered a reliable mechanism to ensure the timely delivery of critical transport infrastructure. The energy sector findings indicate that PPPs have played an important role in expanding access to electricity through support for generation, distribution, and maintenance initiatives. By leveraging private capital and specialized expertise, these partnerships have helped boost the reliability and reach of energy services, easing the pressure on overburdened public utilities.

In the area of information technology, the study showed that PPPs have supported the expansion of digital infrastructure, especially in enhancing internet connectivity, establishing digital service platforms, and advancing e-governance initiatives. Although still evolving, this sector has seen meaningful progress through public-private efforts that promote technological innovation and improve service accessibility. The contribution of PPPs to the health and education sectors is also evident. The results demonstrated that these collaborations have facilitated the development and modernization of hospitals, clinics, schools, and educational institutions. These improvements have helped to expand access to quality healthcare and education, especially in underserved areas. PPPs have enabled the delivery of better learning environments, improved medical facilities, and more efficient service delivery systems, thus supporting broader social development goals.

One of the notable advantages of PPPs identified through this research is their capacity to mobilize private investment to supplement public resources. This approach helps to reduce the infrastructure financing gap and ensures that limited public funds are used more strategically. Furthermore, performance-based agreements typically used in

PPP contracts help to guarantee that service quality is upheld, while creating incentives for innovation, timely delivery, and long-term maintenance. The flexibility of PPP arrangements is another key strength. They allow for diverse financing models, adaptable project structures, and shared risk management. Governments can tailor PPPs to suit the specific needs of different sectors or regions, while benefiting from the project management skills and technical input of private partners. This alignment of responsibilities and incentives encourages collaborative problem-solving and more effective service provision.

Despite the promising results, the study also identified several challenges that hinder the optimal performance of PPPs. These include inconsistencies in the legal and regulatory environment, limited institutional capacity within public agencies to manage complex partnerships, and occasional misalignment between the objectives of the public and private sectors. Additional concerns such as opaque procurement procedures and inadequate monitoring systems were also noted as areas needing improvement. To overcome these obstacles, the research recommends strengthening institutional frameworks, improving policy clarity, and investing in public sector capacity development. The importance of political will and inclusive stakeholder engagement also emerged as a central theme. Successful PPPs are typically found in environments where government commitment is strong, policies are consistent, and communication with stakeholders is open and transparent. In contrast, PPP initiatives tend to falter in contexts marked by policy uncertainty or weak public-private trust. Sustained engagement and collaboration across sectors and interest groups are therefore crucial to achieving long-term success.

The study underscores the transformative role PPPs can play in addressing Nigeria's infrastructure needs. When carefully structured and effectively implemented, PPPs can close delivery gaps, improve the quality and efficiency of infrastructure services, and promote timely execution of projects. This is especially relevant given the country's rapidly growing population, increasing urbanization, and rising demand for modern, reliable infrastructure. From a policy perspective, the results advocate for the integration of PPP strategies into national and subnational development plans. It is essential to institutionalize PPP frameworks, establish clear legal and regulatory mechanisms, and foster a culture of transparency and accountability. Strengthening technical and managerial competencies within the public sector will further enhance the effectiveness of these partnerships. For the private sector, the study offers encouragement that well-structured PPPs provide opportunities for meaningful investment and long-term value creation.

The study also contributes a useful methodological framework for evaluating PPP performance in other regions or sectors. By combining statistical tools with a cross-sectoral approach, it provides a nuanced understanding of the impact of PPPs and lays a foundation for future studies to build upon. Further research could incorporate qualitative methods or comparative analyses across other geopolitical zones to deepen insights into the factors that drive or hinder successful partnerships. It would also be valuable to explore the long-term developmental, social, and equity implications of PPP projects to ensure inclusive outcomes. In conclusion, the study reinforces the understanding that Public-Private Partnerships are a practical, efficient, and impactful approach to infrastructure development in Edo, Delta, and Rivers States. Properly designed and executed PPPs have the potential to close infrastructure gaps, improve public service delivery, and contribute meaningfully to Nigeria's sustainable

development objectives. Based on the findings of this study, the following recommendations are proposed to guide policymakers, government institutions, and development stakeholders. These recommendations are intended to enhance the effectiveness of PPP implementation and to ensure that such partnerships contribute meaningfully to sustainable growth across transportation, energy, information technology, and health and education sectors:

- i. Government institutions and policy actors should give top priority to enhancing the regulatory and institutional framework for implementing Public-Private Partnerships in the transportation sector. This includes establishing clear and consistent policies, promoting fair and open bidding processes, and ensuring accountability. Such measures will help transform private sector participation into more effective, long-lasting, and comprehensive development of transport systems across Edo, Delta, and Rivers States.
- ii. Key players in the energy industry should strengthen their initiatives to attract and sustain private investment by designing PPP models that address critical needs such as increasing power generation, modernizing distribution infrastructure, and extending electricity access to rural communities. These efforts will accelerate the development of the energy sector and close existing infrastructure gaps in the focus states.
- iii. Policymakers should implement forward-thinking PPP strategies geared toward the growth of digital infrastructure. This includes expanding broadband networks, deploying digital governance tools, and establishing technology-driven learning centers. These initiatives will not only drive technological advancement but also promote digital equity and improved public service delivery throughout Edo, Delta, and Rivers States.
- iv. Public agencies should build stronger, more coordinated partnerships with private entities to enhance both the accessibility and quality of infrastructure in health and education. Collaborative investment in the renovation of healthcare facilities, establishment of smart classrooms, and long-term service delivery mechanisms should be prioritized, especially in rural and underserved areas within the selected states.

## **5. ACKNOWLEDGMENTS**

The authors express their sincere appreciation to the Editor and the entire Editorial Team for their valuable support and for considering and publishing this paper. Their professional guidance, constructive review process, and commitment to academic excellence greatly contributed to the successful publication of this study.

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