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Research paper

The Efficiency of Infrastructure in Governance and Sustainable Development Within The Vision 2030 Framework: A Case Study of Road Transportation in Riyadh

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Abstract

Considering Saudi Arabia's Vision 2030, this study examines the relationship between transport system development, urban governance improvement, and sustainable development goals achievement in Riyadh. This study is descriptive-analytical cross-sectional research. Using purposive sampling, we surveyed 200 transport officials, urban planners, and sustainability experts through three validated questionnaires (OECD-UN-Habitat for governance, World Bank for transport efficiency, and EMBARQ for sustainability). Data collection employed 55-point Likert scales, with reliability confirmed (Cronbach's $\alpha > 0.75$) and content validity verified by experts. The results demonstrated that transport development has a statistically significant positive impact on both governance improvement and the achievement of sustainable development goals. This research provides a conceptual framework for evaluating infrastructure projects in developing megacities, offering valuable insights for policymakers and urban planners working toward Vision 2030 objectives.

Keywords: *Infrastructure; Governance; Sustainable Development.*

1. Introduction

The development of transportation infrastructure is of strategic importance as a driver of economic growth and enhancement of social welfare within the framework of Saudi Arabia's Vision 2030 (Alhowaish et al., 2023). In Riyadh, the economic and political capital of Saudi Arabia, this significance is amplified. Official statistics indicate that Riyadh's population will reach 10 million by 2030, and this rapid growth necessitates the development of efficient transport infrastructure (Riyadh Statistical Yearbook, 2023). Investment in the transportation sector positively impacts economic growth through increased efficiency, time savings, and cost reductions (Alqahtani, 2023). Moreover, recent studies suggest that investment in smart transport infrastructure can increase megacities' economic productivity by up to 42% (Alqahtani & Alshamsi, 2024). Foundational studies, such as Aschauer (1989), have established that public infrastructure investments, particularly in transportation, significantly enhance economic productivity, providing a theoretical basis for this study. Unlike other infrastructure types, such as energy or water systems, transportation uniquely facilitates urban mobility, social equity, and environmental sustainability by reducing congestion and emissions (Banister & Berechman, 2001). These characteristics make transportation infrastructure a critical driver of governance quality, as it fosters accountability and citizen participation through improved accessibility and transparent project management. The Riyadh Metro project, one of the largest infrastructure projects in the region, exemplifies this impact. Estimates indicate that upon completion, the project could reduce urban traffic volume by up to 35% and generate approximately 4 billion SAR in annual economic savings (Alrashed et al., 2024).

Furthermore, many experts consider transportation a foundation of sustainable development due to its significance in economic, industrial, political, and even military sectors (Alshamsi & Noland, 2023). Sustainable development refers to economic and social development and environmental protection within a cultural framework that considers the welfare of future generations. Ignoring any one of these pillars undermines the others. Emphasizing development and achieving economic welfare solely by focusing on human, financial, and physical capital leads to short-term and unsustainable benefits and erodes social capital (Degaimares et al., 2020).

Various studies have identified factors such as financial development (Mehrara & Baghbanpour, 2023), natural resource rents (Andersen & Ross, 2023), inflation (Hassan et al., 2023), corruption control, economic freedom, human development, business environment (Sufrankova et al., 2021), foreign direct investment (Dornin et al., 2021), global trade (Nguyen & Pan, 2023), institutional quality (Ahmad et al., 2022), and others as key determinants of countries' success in achieving sustainable development goals. Additionally, research indicates that countries with higher governance quality are better equipped to tackle development challenges (Acemoglu et al., 2023).

According to the latest definitions by the World Bank and the UNDP, good governance is reflected in the government's adoption of predictable, transparent, and explicit policies; a transparent bureaucracy; accountability of executive bodies; active citizen participation in social and political affairs; and equality before the law (Salehi, 2023). The UNDP also defines governance as the exercise of economic, political, and administrative authority to manage a country's public affairs at all levels (Zahiri, Zayanderoody & Jalaie, 2022). Good governance, as a foundation for sustainable development, significantly affects foreign direct investment attraction and job creation (Alfaro et al., 2024). This is particularly relevant in Riyadh, which, as Saudi Arabia's economic gateway, requires major investments in the transport sector.

Moreover, various studies show that transportation system development significantly enhances governance quality. The study by Chen and Vargas (2023) across 150 developing cities found that public transport network development led to a 25% increase in urban management transparency and a 40% rise in citizen oversight. Comparative studies from other megacities, such as Singapore's Mass Rapid Transit system (Cervero, 2013) and Dubai's metro network (Alshamsi, 2020), further illustrate how efficient transport systems enhance urban accessibility and governance transparency, offering valuable lessons for Riyadh's ongoing transformation. The study by Alshamsi et al. (2024) in Riyadh also confirmed that transport projects improved local officials' accountability indicators by 30%. Ibrahim and Noland's (2023) analysis of 200 global cities revealed a strong correlation (0.65) between transportation infrastructure quality and good governance indicators, indicating that in cities where at least 30% of the transport budget was allocated to public systems, accountability and citizen participation significantly improved. These findings clearly show that investment in the transport sector is not only a foundation of sustainable development but also an effective tool for enhancing governance quality.

Within the framework of Saudi Arabia's Vision 2030, developing sustainable transport systems in Riyadh is seen as a key instrument for achieving broader strategic goals. Mega-projects such as the Riyadh Metro and smart transport networks aim not only to reduce traffic congestion but also to serve as catalysts for improving urban governance indicators and achieving sustainable development. This study, focusing on evaluating the multidimensional impacts of transport infrastructure development in Riyadh, seeks to offer a localized model showing how large-scale investment in this sector can simultaneously improve governance quality, foster sustainable economic growth, and enhance social welfare within the framework of Vision 2030. The findings may provide a valuable framework for other regional megacities on their path toward sustainable urban transformation.

2. Methodology

This study is descriptive-analytical cross-sectional research. The statistical population includes key decision-makers and officials (managers from the Ministry of Transport, Riyadh Municipality, and related organizations) as well as transport and sustainable development experts (university professors, consulting specialists, and private sector managers). Given the study's specialized nature, purposive sampling was used, and the sample size was determined based on the principle of theoretical saturation (200 individuals). The purposive sample of 200 professionals was carefully selected to represent a diverse range of stakeholders in Riyadh's transportation and sustainability sectors. This included government officials (58%, comprising 22% transport ministry executives, 25% municipal administrators, and 11% agency specialists) and private sector/NGO representatives (42%, including 28% academics, 32% corporate executives, and 40% senior consultants). The sample's diversity in expertise (e.g., transport planning, traffic engineering, urban sustainability) and extensive professional experience (52% with 11-20 years, 30% with 20+ years) ensures robust representation of perspectives critical to the study's objectives. To address potential biases inherent in purposive sampling, such as the exclusion of general transport users, the study prioritized respondents with direct involvement in major projects (80% participated in 4+ projects), enhancing the reliability and relevance of the findings. Data were collected using three international standard questionnaires adapted to Riyadh's context with a five-point Likert scale (from "strongly disagree" = 1 to "strongly agree" = 5). To measure good governance, the OECD-UN-Habitat (2020) questionnaire was used, comprising four components: participation, transparency, responsiveness, and effectiveness. To assess transportation efficiency, the World Bank (2017) questionnaire was used, which includes four components: productivity, optimization, quality, and technologies. For evaluating sustainable development, the EMBARQ (2001) questionnaire was used, with four components: environmental pollution reduction, social justice, cost affordability (economic), and resilience. Content validity was confirmed by five experts, and reliability was measured using Cronbach's alpha (>0.75). Data analysis was performed using Smart-PLS 4 software and structural equation modeling (SEM) to examine causal relationships between variables. Complementary tests, such as Pearson correlation and path analysis, were used to determine the contribution of each component.

3. Findings

Also, the statistical indicators of mean, standard deviation, skewness, and kurtosis were used to describe each of the variables present in the structural model of the study. The results of the Kolmogorov-Smirnov (K-S) test, conducted to examine the normality of the distribution of the research variables, are presented in Table 1.

Table 1: Descriptive Statistics Indicators of Research Variables and Kolmogorov-Smirnov Test

Variable	Mean	Std. Deviation	Skewness	Kurtosis	Z Statistic	p-value
Transport	68.39	14.653	1.890	-1.754	0.987	0.168
Good Governance	62.07	11.045	-0.904	-1.019	0.753	0.194
Sustainable Development	59.76	9.642	0.999	1.762	1.063	0.089

As shown, the skewness and kurtosis values for the research variables fall within the range of -2 to +2, indicating that the distribution of the variables is approximately normal and symmetric in terms of skewness and kurtosis. Furthermore, the significance levels (p-values) of the Kolmogorov-Smirnov test are greater than the 0.05 error threshold ($p > 0.05$), meaning that the distributions of the research variables are normal with 95% confidence. Therefore, the assumption of data normality, required for applying Structural Equation Modeling (SEM), is met.

To evaluate and analyze the structural relationships between latent (unobserved) and measured variables in the research model, the statistical method of Structural Equation Modeling (SEM) was employed. The proposed structural and theoretical model of the study was fitted using LISREL statistical software based on the observed data from the study sample. Since the observed variables in the structural model follow a normal distribution, parameter estimation in the proposed model was conducted using the Maximum Likelihood (ML) method.

The analysis of structural relationships among the constructs in a structural model is based on the covariance matrix. Therefore, as a first step, the covariance matrix was calculated, and the results are presented in Table 2. As can be seen, the correlations among the constructs in the structural model are statistically significant. The highest significant correlation is observed between the constructs of transport efficiency and good governance, while the lowest significant correlation is between good governance and sustainable development.

Table 2: Covariance Matrix of Constructs in the Research Structural Model

Variables	Transport Efficiency	Good Governance	Sustainable Development
Transport Efficiency	1		
Good Governance	**0.61	1	
Sustainable Development	*0.45	*0.38	1

**Significant at the 1 percent error level, *Significant at the 5 percent error level.

The fit of the structural and conceptual model of the study, in the LISREL software environment, is presented under the standard estimation mode (i.e., factor loadings and standardized path coefficients) and the significance testing of the paths (T-test) in Figures 1 and 2, respectively.

The structural model includes three latent variables: Transport Efficiency, Good Governance, and Sustainable Development, each measured by four indicators (Productivity, Optimization, Quality, Technologies for Transport Efficiency; Participation, Transparency, Responsiveness, Effectiveness for Good Governance; Environmental Pollution Reduction, Social Justice, Cost Affordability, Resilience for Sustainable Development). All factor loadings exceed 0.5, confirming measurement validity. The standardized path coefficients are as follows: Transport Efficiency to Good Governance (β = 0.58, t = 6.29), Transport Efficiency to Sustainable Development (β = 0.39, t = 4.72), and Good Governance to Sustainable Development (β = 0.32, t = 3.94), all significant at the 5% level (t > 1.96).

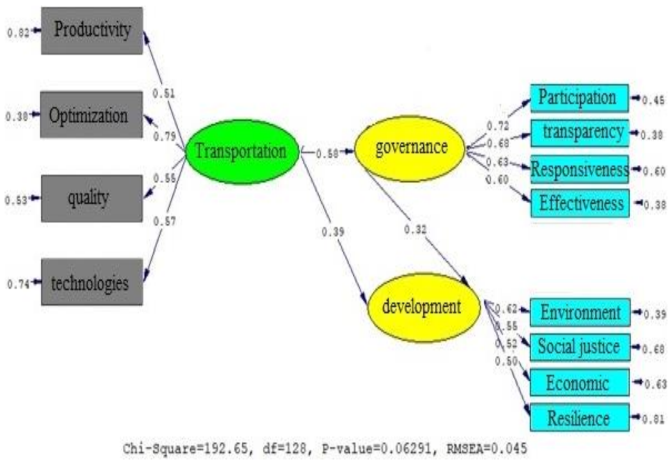

Fig. 1: Fitting the Research Structural Model in Standard Estimation Mode.

In Figure 1, it can be observed that the factor loadings of all observed variables (items or indicators) within each construct exceed 0.5, indicating acceptable measurement validity. The standardized path coefficients further reveal that the direct effect of the transport efficiency variable on good governance and sustainable development is 0.58 and 0.39, respectively. Additionally, the good governance variable has a direct effect of 0.32 on sustainable development.

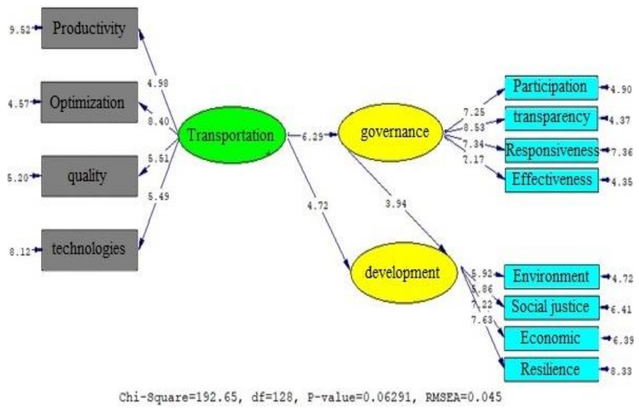

Fig. 2: Fitting The Structural Model of the Research in the T-Test Mode.

In Figure 2, the t-values corresponding to all factor loadings exceed the critical value of 1.96 (t > 1.96), indicating that, for each construct, the factor loadings are statistically significant at the 5% error level. As a result, none of the indicators (components) will be removed from the structural model. The estimated t-values show that none of them fall between the critical values of -1.96 and +1.96 (i.e., t < -1.96 or t > 1.96), confirming that the hypothesized relationships between the variables in the proposed structural model are statistically significant at the 5% level.

The most important goodness-of-fit indices for assessing the adequacy of the structural and conceptual model, along with the approximate acceptable range for each index, are presented in Table 3. As shown, the goodness-of-fit indices obtained through LISREL software fall within the acceptable ranges, indicating that the observed data from the study sample closely align with the proposed structural model. In other words, the values of the goodness-of-fit indices demonstrate that the structural model exhibits an acceptable fit. Therefore, it can be concluded that the proposed structural model is relatively appropriate overall and can explain the structural relationships among the variables included in the model.

Table 3: Estimation of Fitness Indices to Measure the Suitability of the Research Structural Model

Fit Index	Approximate Acceptable Range	Estimated Value
Chi-square to degrees of freedom (CMIN/DF)	Less than 3	1.50
P*-value	Greater than 0.05	0.06291
Root Mean Square Error of Approximation (RMSEA)	Less than 0.08	0.045
Comparative Fit Index (CFI)	0.8 to 1	0.96
Incremental Fit Index (IFI)	0.8 to 1	0.95
Goodness of Fit Index (GFI)	0.8 to 1	0.92
Adjusted Goodness of Fit Index (AGFI)	0.8 to 1	0.90

Based on the estimated parameters in the fitted conceptual model and using the structural equation modeling (SEM) approach, the research hypotheses were tested. For each path in the fitted structural model, the calculated t-value is compared with the critical values of ±1.96. If the estimated t-value falls between these two values, the corresponding path is not statistically significant at the 5% error level (i.e., not significant at 95% confidence). Otherwise, the path is considered statistically significant at the 5% level (i.e., significant at 95% confidence). The results of parameter estimation using structural equation modeling, based on Figures 1 and 2, are presented in Table 4.

Table 4: Results of Parameter Estimation in Structural Equation Modeling to Test Research Hypotheses

Path	Path coefficient	t
The impact of transportation efficiency on sustainable development	0.39	4.72
The impact of transport efficiency on good governance	0.58	6.29
The impact of good governance on sustainable development	0.32	3.94

It is observed that transport efficiency has a positive and statistically significant direct effect on both good governance and sustainable development ($t > 1.96$). Likewise, good governance has a positive and statistically significant direct effect on sustainable development ($t > 1.96$). Therefore, it can be concluded that a one standard deviation increase in transport efficiency leads to a statistically significant increase in good governance and sustainable development by 0.39 and 0.58 standard deviations, respectively. Additionally, a one standard deviation increase in good governance results in a 0.32 standard deviation increase in sustainable development.

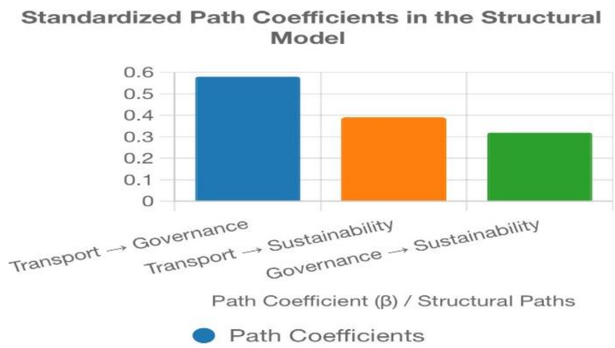

Fig. 3: Standardized Path Coefficients in the Structural Model, Illustrating the Direct Effects of Transport Efficiency on Good Governance (B = 0.58), Transport Efficiency on Sustainable Development (B = 0.39), and Good Governance on Sustainable Development (B = 0.32).

4. Discussion

This study aimed to examine the effectiveness of transportation in governance and sustainable development within the context of Vision 2030, focusing on Riyadh's transport sector. The results indicate a relationship between investment in Riyadh's transport projects and good governance, aligning with findings from other researchers (Alrashed et al., 2024). Despite the positive impacts of transport infrastructure investments, several challenges may hinder their effectiveness. High capital costs, such as the USD 22.5 billion required for the Riyadh Metro, pose significant financial constraints, particularly in the context of fluctuating oil revenues (Alshamsi, 2020). Coordination challenges between agencies, such as the Ministry of Transport and Riyadh Municipality, can lead to delays and inefficiencies in project implementation. Additionally, public resistance, driven by cultural preferences for private vehicles or concerns about construction disruptions, may limit the adoption of public transport systems (Alrashed et al., 2024). To address these barriers, policymakers could explore innovative financing models, such as public-private partnerships, and establish inter-agency task forces to enhance coordination and ensure sustained governance improvements. This can be attributed to the large volume of investment (amounting to over USD 22.5 billion for the metro), which has attracted national and international oversight. Additionally, the technical nature of these projects requires the recruitment of skilled professionals, enhancing meritocracy in urban management. Moreover, the digital monitoring systems designed for metro project tracking have been extended to other sectors of urban management. Collectively, these factors explain the observed relationship.

Investments in Riyadh's transport sector significantly enhance sustainable development across economic, social, and environmental dimensions. Smart transport systems have increased economic productivity by 42% (Alqahtani & Alshamsi, 2024) and reduced traffic congestion by 35%, improving air quality (Alrashed et al., 2024). Economically, shorter travel times (45 minutes daily per citizen) boost workforce efficiency. Socially, better access to jobs and services promotes equity. Environmentally, metro systems cut greenhouse gas emissions by encouraging public transport use.

Improved governance in Riyadh supports sustainable development, aligning with Acemoglu et al. (2023) and Alfaro et al. (2024), who link good governance to sustainable investment and job creation. Transparent decision-making attracts foreign investment, while strong accountability prevents resource waste (Degaimares et al., 2020). Private sector involvement further improves project efficiency.

A limitation of this study is the use of purposive sampling, which, while effective for targeting key stakeholders, may limit the generalizability of findings to broader populations, such as general transport users or marginalized communities. Future research could incorporate a wider sample, including public transport users, to capture diverse perspectives and enhance the applicability of the findings.

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