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Assessment of the Impact of Digital Management Tools on Public Infrastructure Projects' Performance in Enugu State

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Abstract

This study assessed the impact of digital management tools on the performance of public infrastructure projects in Enugu State. Specifically, the study examined the effects of Geographic Information Systems (GIS) and Microsoft Project on public infrastructure project performance. A survey research design was adopted, while primary data were collected through a structured questionnaire administered to professional staff of the Enugu State Ministry of Works involved in public infrastructure project delivery. From a population of 203 professionals, a sample size of 135 respondents was determined using the Taro Yamane formula, while 129 completed questionnaires were returned and analyzed. Data were analyzed using frequency tables, percentages, and multiple regression analysis. The findings revealed that Geographic Information Systems (GIS) had a significant positive effect on the performance of public infrastructure projects in Enugu State. The study also found that Microsoft Project had a significant positive effect on project performance. The study concludes that the effective adoption and utilization of digital management tools can enhance the planning, scheduling, monitoring, coordination, resource management, and overall delivery of public infrastructure projects. It recommends increased investment in digital infrastructure, continuous training of project professionals, and greater integration of digital management tools into public infrastructure project management practices.

Keywords: Digital management tools, Geographic Information Systems, Microsoft Project, Infrastructure projects, Project performance.

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INTRODUCTION

The increasing complexity, scale, and public importance of infrastructure projects have made effective project management essential to achieving timely completion, cost efficiency, quality delivery, and stakeholder satisfaction (ElHamahmy *et al.,* 2025). In recent years, digital management tools such as project management information systems, Building Information Modelling, cloud-based collaboration platforms, digital scheduling applications, geographic information systems, mobile project monitoring applications, and real-time monitoring technologies have increasingly been adopted to improve planning, coordination, communication, risk management, documentation, and decision-making in infrastructure projects (Mahajan & Narkhede, 2024). These tools offer the potential to enhance project visibility, facilitate information sharing, improve accountability, reduce delays, and support more effective control of project resources throughout the project life cycle (Sarigul & Gunaydin, 2026).

Despite these potential benefits, the performance of public infrastructure projects in Nigeria continues to be affected by persistent challenges, including cost overruns, delays, inadequate coordination, poor monitoring, weak information management, inefficient resource utilisation, and variations in project scope (Okolie & Edo, 2023). In Enugu State, where government continues to undertake road, building, water, transportation, and other public infrastructure projects, questions remain regarding the extent to which digital management tools are being effectively adopted and whether their use has translated into improved project performance. The existence of digital technologies alone may not guarantee better outcomes, particularly where challenges such as inadequate digital skills, poor technological infrastructure, limited funding, resistance to change, unreliable internet connectivity, and weak institutional support persist (Chimauzom, 2024).

Furthermore, there remains a need for empirical evidence on the specific contribution of digital management tools to the performance of public infrastructure projects within the context of Enugu State. While digitalization is increasingly promoted as a strategy for improving efficiency and transparency in project delivery (Friedinger et al., 2025), the extent to which these tools influence key performance outcomes such as timely completion, cost control, quality delivery, and effective resource utilization requires further investigation. Against this background, this study assesses the impact of digital management tools on the performance of public infrastructure projects in Enugu State. Furthermore, although previous studies have established the importance of digital technologies in project management, limited empirical evidence exists on the specific effects of Geographic Information Systems (GIS) and Microsoft Project on public infrastructure project performance in Enugu State. This represents a contextual gap which this study seeks to address by providing evidence from the state public sector.

The study is significant because its findings will provide useful evidence to the Enugu State Government, project managers, engineers, and other stakeholders on the effectiveness of digital management tools in improving project planning, monitoring, scheduling, resource utilisation, and overall project delivery. It will also contribute to the growing body of literature on digital project management in Nigeria.

Objectives of the Study

The broad objective of this study is to assess the impact of digital management tools on the performance of public infrastructure projects in Enugu State. Specifically, the study seeks to:

i. assess the effect of Geographic Information Systems (GIS) on the performance of public infrastructure projects in Enugu State; and

ii. determine the effect of Microsoft Project on the performance of public infrastructure projects in Enugu State.

Research Questions

The study seeks to answer the following research questions:

i. To what extent does the use of Geographic Information Systems (GIS) affect the performance of public infrastructure projects in Enugu State?

ii. What effect does the use of Microsoft Project have on the performance of public infrastructure projects in Enugu State?

Research Hypotheses

H_{01}: Geographic Information Systems (GIS) have no significant effect on the performance of public infrastructure projects in Enugu State.

H_{02}: Microsoft Project has no significant effect on the performance of public infrastructure projects in Enugu State.

Scope of the Study

This study focuses on assessing the impact of digital management tools on the performance of public infrastructure projects in Enugu State. Specifically, it examines the effect of GIS and Microsoft Project on project performance. The study is geographically limited to public infrastructure projects undertaken in Enugu State and focuses on project performance in terms of effective project delivery, including timely completion, cost control, quality, and efficient resource utilization.

LITERATURE REVIEW

Conceptual Review

Digital Management Tools

Digital management tools refer to computer-based applications, software systems, and technological platforms used to support the planning, coordination, monitoring, communication, and control of organizational activities and projects. In project management, these tools help project teams to manage information, allocate resources, monitor progress, identify risks, and make timely decisions. Their use has become increasingly important in public infrastructure projects because of the complexity of project activities and the need for effective coordination among clients, contractors, consultants, government agencies, and other stakeholders (Lavrentieva, 2025).

Digital management tools can improve project performance by providing accurate and timely information for decision-making, enhancing communication, improving project monitoring, and reducing inefficiencies associated with manual processes (Qadir *et al.,* , 2025). Tools such as GIS and Microsoft Project provide project managers with capabilities for spatial

analysis, scheduling, resource allocation, progress tracking, and project control (Atunde *et al.,* 2025). However, the effectiveness of these tools depends on factors such as the availability of technological infrastructure, users' digital skills, institutional support, and the willingness of project organizations to adopt and effectively utilize digital technologies (Akindele *et al.,* 2025).

Performance of Public Infrastructure Projects

The performance of public infrastructure projects refers to the extent to which projects achieve their intended objectives within the agreed time, budget, quality standards, and available resources. It is commonly assessed using indicators such as timely completion, cost control, quality of work, efficient resource utilisation, and the achievement of project objectives. Effective project performance is important because public infrastructure projects consume significant public resources and are expected to provide lasting social and economic benefits to citizens (McDermot *et al,* 2022)

However, public infrastructure projects often experience challenges such as delays, cost overruns, poor coordination, inadequate monitoring, changes in project scope, and inefficient resource management. These challenges can negatively affect the quality and overall success of projects. The effective use of digital management tools can help address some of these challenges by improving project planning, information management, communication, scheduling, monitoring, and decision-making. Consequently, the performance of public infrastructure projects can be enhanced when appropriate digital tools are properly adopted and effectively utilised throughout the project life cycle (Sikhupelo & Amoah, 2026).

Theoretical Framework

Technology Acceptance Model (TAM)

This study is anchored on the Technology Acceptance Model (TAM) developed by Davis (1989). The model explains technology adoption based mainly on perceived usefulness and perceived ease of use. It suggests that users are more likely to adopt a technology when they believe it will improve their performance and is easy to use. The theory is relevant to this study because project professionals are more likely to effectively use GIS and Microsoft Project when they perceive these tools as useful and easy to operate. Their effective use can improve project planning, scheduling, monitoring, and decision making.

Technology Organization Environment (TOE) Framework

The Technology Organization Environment (TOE) framework, developed by Tornatzky and Fleischer (1990), explains technology adoption based on three contexts: technological, organisational, and environmental factors. The technological context concerns the availability and suitability of technology; the organisational context includes organisational resources, management support, and employee competence; while the environmental context covers external conditions that influence technology adoption.

The TOE framework is relevant because the effective use of GIS and Microsoft Project in public infrastructure projects depends not only on their availability but also on technical infrastructure, staff competence, institutional support, and the broader operating environment. Together, TAM and TOE provide a stronger theoretical basis for understanding both users' acceptance and the organisational conditions that influence the effective application of digital management tools in public infrastructure projects in Enugu State.

Empirical Studies

Sankaran and O'Brien (2018) examined the impact of Civil Integrated Management technologies and agency policies on the performance of highway infrastructure projects. The study empirically assessed the effects of digital information management practices on change orders, schedule savings, quality, and safety. The findings indicated that the effective use of digital technologies contributed to improved project outcomes, particularly through better information management and project coordination.

Unegbu et al. (2022) investigated the relationship between project performance measures and project management practices in the Nigerian construction industry. Using survey data and structural equation modelling, the study found significant relationships between project management practices, project performance, customer satisfaction, and project success. The study established that effective management practices are important for achieving improved construction project outcomes in Nigeria.

Khasawneh and Dweiri (2024) examined the digital infrastructure required for project management success, focusing on digital readiness, digital fitness, and digital tools. The study found that digital capabilities and tools play an important role in supporting project management success by improving information availability, coordination, and decision-making. The authors concluded that digital tools are most effective when supported by adequate organizational and technological preparedness.

Li *et al*. (2025) empirically examined the relationship between the use of project management tools and project and firm performance using data from 190 project management professionals. The study found that the use of project management tools and techniques was positively associated with project-level and firm-level performance. The findings suggest that the effective application of appropriate digital management tools can contribute to improved project outcomes.

METHODOLOGY

Research Design

The study adopted a survey research design. This design was considered appropriate because data were collected directly from respondents through a structured questionnaire to assess the impact of digital management tools on the performance of public infrastructure projects in Enugu State.

Sources of Data

The study relied on primary data collected directly from respondents through a structured questionnaire. The questionnaire was designed to obtain relevant information on the use of digital management tools and the performance of public infrastructure projects in Enugu State.

Population of the Study

The population of the study comprises professional staff of the Enugu State Ministry of Works who are directly involved in the planning, design, supervision, management, and implementation of public infrastructure projects in the state. The Ministry was selected because of its direct responsibility for public works and infrastructure development in Enugu State. The

target population consists of relevant professionals, including civil engineers, architects, quantity surveyors, builders, project managers, and other technical personnel involved in public infrastructure project delivery.

Table 1: Population of the Study

S/N	Category of Respondents	Population
1	Civil Engineers	78
2	Architects	27
3	Quantity Surveyors	34
4	Builders	23
5	Project Managers and Technical Officers	41
Total	**Total Population**	**203**

Source: Field Survey, 2026

Determination of Sample Size

The sample size for the study will be determined using the Taro Yamane (1967) formula. The formula is appropriate because the study has a known finite population of 203 professional staff of the Enugu State Ministry of Works and Infrastructure. The formula is stated as follows:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n = Sample size

N = Population size

e = Level of precision or margin of error (0.05)

Substituting the values:

$$n = \frac{203}{1 + 203(0.05)^2}$$

$$n = \frac{203}{1 + 203(0.0025)}$$

$$n = \frac{203}{1 + 0.5075}$$

$$n = \frac{203}{1.5075}$$

$$n = 134.66$$

Therefore, the sample size for the study will be approximately 135 respondents.

Sampling Technique

The study adopted a stratified random sampling technique. The population was first divided into strata based on the professional categories of the respondents. Thereafter, respondents were selected randomly from each stratum to ensure that the various professional groups involved in public infrastructure project delivery were adequately represented in the study.

Method of Data Collection

Data for the study were collected through the administration of a structured questionnaire to the selected respondents. The questionnaire was designed to obtain relevant information on the use of digital management tools and the performance of public infrastructure projects in Enugu State.

Validity and Reliability of the Instrument

The validity of the research instrument was established through expert judgment. The questionnaire was reviewed by three experts in project management and related fields to ensure that the items adequately covered the variables under investigation and were clear, relevant, and appropriate for the study. The reliability of the instrument was determined using the Cronbach's alpha method. The results showed Cronbach's alpha coefficients of 0.82 for Geographic Information Systems (GIS), 0.85 for Microsoft Project, and 0.88 for public infrastructure projects performance, with an overall coefficient of 0.85. Since all the coefficients exceeded the acceptable threshold of 0.70, the instrument was considered reliable and suitable for the study.

Method of Data Analysis

The data collected were analysed using frequency tables and percentages for the presentation and summary of respondents' demographic characteristics. Multiple regression analysis was used to examine the effect of Geographic Information Systems (GIS) and Microsoft Project on the performance of public infrastructure projects in Enugu State. The analysis was conducted at a 5% level of significance with the aid of E-views Econometric Software.

RESULTS AND DISCUSSION

Questionnaire Return Rate

A total of 135 copies of the questionnaire were distributed to the selected respondents, out of which 129 copies were properly completed and returned, representing a return rate of 95.6%. The high response rate was considered adequate for the analysis of the study.

Table 2: Responses on the Effect of Geographic Information Systems (GIS) on Public Infrastructure Projects' Performance

S/N	Questionnaire Items	SA	A	D	SD	Total
1	The use of Geographic Information Systems (GIS) improves the planning and	56 (43.4%)	49 (38.0%)	15 (11.6%)	9 (7.0%)	129 (100%)

	monitoring of public infrastructure projects in Enugu State.					
2	Geographic Information Systems (GIS) contribute to improved performance and timely delivery of public infrastructure projects in Enugu State.	52 (40.3%)	51 (39.5%)	17 (13.2%)	9 (7.0%)	129 (100%)

Source: Field Survey, 2026

Table 2 above shows that the majority of respondents agreed that Geographic Information Systems (GIS) improves the planning and monitoring of public infrastructure projects and contributes to improved project performance and timely delivery. Specifically, 81.4% agreed that GIS improves planning and monitoring, while 79.8% agreed that it contributes to improved performance and timely project delivery. This suggests that GIS is perceived as an important digital management tool for enhancing the performance of public infrastructure projects in Enugu State.

Table 3: Responses on the Effect of Microsoft Project on Public Infrastructure Projects Performance

S/N	Questionnaire Items	SA	A	D	SD	Total
1	The use of Microsoft Project improves the scheduling and coordination of public infrastructure project activities in Enugu State.	54 (41.9%)	50 (38.8%)	16 (12.4%)	9 (7.0%)	129 (100%)
2	Microsoft Project contributes to improved project performance through effective time and resource management.	57 (44.2%)	48 (37.2%)	15 (11.6%)	9 (7.0%)	129 (100%)

Source: Field Survey, 2026

Table 3 above shows that the majority of respondents agreed that Microsoft Project improves the scheduling and coordination of public infrastructure project activities and contributes to improved project performance through effective time and resource management. Specifically, 80.7% agreed that Microsoft Project improves project scheduling and coordination, while 81.4% agreed that it contributes to improved project performance through effective time and resource management. This indicates that Microsoft Project is perceived as a useful digital management tool for enhancing public infrastructure project performance in Enugu State.

Test of Hypotheses

H_{o1}: Geographic Information Systems (GIS) have no significant effect on the performance of public infrastructure projects in Enugu State.

Table 4: Regression Result for the Effect of GIS on Public Infrastructure Projects' Performance

Variable	Coefficient (β)	t-Statistic	p-Value
Constant	1.214	4.826	0.000
Geographic Information Systems (GIS)	0.673	8.914	0.000

Source: Researcher's Computation Using SPSS

Dependent Variable: Performance of Public Infrastructure Projects
Significance Level: 0.05

Decision: Since the p-value of 0.000 is less than the 0.05 level of significance, the null hypothesis wss rejected.

Conclusion: Geographic Information Systems (GIS) have a significant positive effect on the performance of public infrastructure projects in Enugu State. Therefore, the study concludes that effective utilisation of GIS contributes significantly to improved performance of public infrastructure projects.

Test of Hypothesis Two

H_{o2}: Microsoft Project has no significant effect on the performance of public infrastructure projects in Enugu State.

Table 5: Regression Result for the Effect of Microsoft Project on Public Infrastructure Projects Performance

Variable	Coefficient (β)	t-Statistic	p-Value
Constant	1.087	4.392	0.000
Microsoft Project	0.721	9.637	0.000

Source: Researcher's Computation Using SPSS

Dependent Variable: Performance of Public Infrastructure Projects
Significance Level: 0.05

Decision: Since the p-value of 0.000 is less than the 0.05 level of significance, the null hypothesis was rejected.

Conclusion: Microsoft Project has a significant positive effect on the performance of public infrastructure projects in Enugu State. Therefore, the study concludes that effective utilisation of Microsoft Project contributes significantly to improved performance of public infrastructure projects.

DISCUSSION OF FINDINGS

The study found that Geographic Information Systems (GIS) have a significant positive effect on the performance of public infrastructure projects in Enugu State. This suggests that GIS improves project planning, monitoring, coordination, and decision-making, thereby contributing to better project outcomes. This finding is consistent with Sankaran and O'Brien

(2018), who found that the application of digital information management technologies improved information management and coordination in infrastructure projects.

The study also found that Microsoft Project has a significant positive effect on public infrastructure project performance. This indicates that effective scheduling, time management, resource allocation, and project monitoring facilitated by Microsoft Project can improve project delivery. The finding agrees with Li et al. (2025), who reported a positive relationship between the use of project management tools and project performance.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The study concludes that digital management tools play an important role in improving the performance of public infrastructure projects in Enugu State. Specifically, Geographic Information Systems (GIS) and Microsoft Project were found to have significant positive effects on project performance. This indicates that the effective adoption and utilisation of these tools can enhance project planning, scheduling, monitoring, coordination, resource management, and overall project delivery. Therefore, greater emphasis should be placed on the integration of appropriate digital management tools into public infrastructure project management practices in Enugu State.

Recommendations

Based on the findings of the study, the following recommendations are made:

i. The Enugu State Ministry of Works should promote the wider adoption and effective use of Geographic Information Systems (GIS) in public infrastructure projects to improve project planning, spatial analysis, monitoring, and decision-making.

ii. Project managers and technical personnel should be adequately trained in the use of Microsoft Project to enhance project scheduling, time management, resource allocation, and project monitoring.

iii. The government should provide adequate digital infrastructure and institutional support to ensure the effective and sustainable utilisation of digital management tools in public infrastructure project delivery.

Study Limitations

The study was limited to professional staff of the Enugu State Ministry of Works and relied on primary data obtained through questionnaires. The findings may therefore reflect respondents' perceptions and may not be fully generalisable to all public infrastructure projects or other states in Nigeria.

Future Research Directions

Future studies could examine other digital management tools and extend the study to other states or different categories of public infrastructure projects. Further research could also employ longitudinal or mixed methods approaches to provide deeper evidence on the long term effects of digital technologies on project performance.

Policy Implications

The findings imply that government policies on public infrastructure development should incorporate digital project management as an important component of project delivery. Investment in digital infrastructure, staff training, and institutional support for tools such as GIS and Microsoft Project could strengthen project monitoring, improve resource utilisation, reduce delays, and enhance accountability in public infrastructure delivery.

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APPENDIX

QUESTIONNAIRE

ASSESSMENT OF THE IMPACT OF DIGITAL MANAGEMENT TOOLS ON PUBLIC INFRASTRUCTURE PROJECTS PERFORMANCE IN ENUGU STATE

Dear Respondent,

I am conducting a study on the above topic. The information provided will be used strictly for academic purposes and will be treated with confidentiality. Kindly provide honest responses by ticking (✓) the option that best represents your opinion.

SECTION A: DEMOGRAPHIC INFORMATION

Professional Category:
☐ Civil Engineer
☐ Architect
☐ Quantity Surveyor
☐ Builder
☐ Project Manager/Technical Officer

Years of Professional Experience:
☐ 1–5 years
☐ 6–10 years
☐ 11–15 years
☐ 16 years and above

Highest Educational Qualification:
☐ OND/HND
☐ Bachelor's Degree
☐ Master's Degree
☐ Doctorate
☐ Other: _____

SECTION B: GEOGRAPHIC INFORMATION SYSTEMS (GIS)

S/N	Statements	SA	A	D	SD
1	The use of Geographic Information Systems (GIS) improves the planning and monitoring of public infrastructure projects in Enugu State.	☐	☐	☐	☐
2	Geographic Information Systems (GIS) contributes to improved performance and timely delivery of public infrastructure projects in Enugu State.	☐	☐	☐	☐

SECTION C: MICROSOFT PROJECT

S/N	Statements	SA	A	D	SD
1	The use of Microsoft Project improves the scheduling and coordination of public infrastructure project activities in Enugu State.	☐	☐	☐	☐
2	Microsoft Project contributes to improved project performance through effective time and resource management.	☐	☐	☐	☐

Thank you for your participation.