Assessment of Digital Project Management Tools in Enugu Metropolis Engineering Firms

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Abstract

This study assessed the adoption, effectiveness, and impact of digital project management tools in selected engineering firms in Enugu Metropolis. Specifically, the study sought to identify the types of digital project management tools in use, examine the influence of employee digital literacy on tool utilization, and evaluate the relationship between tool usage and project cost control outcomes. A descriptive survey research design was adopted. The population comprised 346 project-related professionals drawn from five purposively selected engineering firms. Using Yamane's formula and Bourley's proportional allocation method, a sample size of 186 respondents was determined. A structured questionnaire was used as the primary instrument for data collection, and the data were analyzed using descriptive statistics, including percentages, mean, and standard deviation. The findings revealed a diverse range of digital project management tools in use, with Microsoft Project (59.1%) and Primavera P6 (40.9%) being the most prevalent. The analysis of the second objective indicated a grand mean score of 4.64 on a 5-point scale, signifying a strong perceived influence of employee digital literacy on the effective utilization of the tools. Similarly, the third objective, which examined project cost control outcomes, recorded an overall mean score of 4.58 on a 5-point scale, indicating that the use of digital project management tools significantly enhances cost efficiency. The study concluded that digital project management tools are widely adopted in engineering firms and that their effective utilization is strongly influenced by employees' digital literacy, with a demonstrable positive impact on project cost control. It was recommended that engineering firms should prioritize the adoption of versatile, industry-relevant digital project management tools that align with their project scale and operational needs.

Keywords: *Digital Project Management Tools; Engineering Firms; Digital Literacy; Project Cost Control; Project Management Software; Construction and Engineering Projects; Enugu Metropolis.*

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Introduction

In the evolving global construction and engineering industry, the integration of digital technologies into project management has become an important determinant of operational efficiency, cost optimization, and timely project delivery. Digital Project Management Tools (DPMTs) such as Microsoft Project, Trello, Asana, and Primavera are designed to enhance collaboration, task tracking, scheduling, and resource allocation. These tools represent a shift from traditional, manual methods of project oversight to more agile and automated systems that leverage cloud computing, real-time data access, and AI-enhanced analytics. In developed economies, the adoption of DPMTs has reached maturity. However, Fwah, Ibanga and Philip (2024) observed that in many developing regions, including Nigeria, the process remains nascent and unevenly distributed across sectors and organizational types.

The adoption of DPMTs by engineering firms in Nigeria is shaped by multiple interrelated factors, including organizational readiness, digital infrastructure, workforce competencies, and regulatory dynamics. Aliu et al. (2025) showed that while digitalization in Nigerian engineering and construction sectors is gaining momentum, significant gaps remain in tool adoption and integration. The study confirmed that tools like cloud-based project management platforms significantly enhance competitive advantage by improving resource coordination, real-time monitoring, and data-driven decisions. However, these benefits are only realized when supported by adequate digital capacity and strategic alignment at the firm level.

Despite growing awareness of digital tools, many engineering firms in Nigeria still rely heavily on manual or hybrid project management systems. Asenuga et al. (2022) observed that while a significant number of firms in Southwestern Nigeria use scheduling tools such as Microsoft Project and Primavera, about 32% still rely entirely on manual systems. This mixed adoption points to underlying challenges such as cost of software acquisition, limited technical expertise, and low institutional support. These issues are compounded in regions like Enugu State, where infrastructure disparities and lower access to ICT training further hinder full digital integration.

A core challenge in the adoption of DPMTs in Nigeria is the disparity in employees' digital literacy levels. The workforce's ability to effectively utilize project management software is often undermined by limited formal training, insufficient exposure to digital tools, and a lack of continuous professional development programs. Fwah, Ibanga and Philip (2024) highlighted that technical institutions in Nigeria frequently fall short in equipping engineering educators with the digital competencies necessary for 21st-century industry needs. Consequently, many practicing engineers enter the workforce with only rudimentary digital skills, which restricts the effective application of digital tools in real-world projects.

Moreover, project cost control which is a critical performance metric in engineering management; is significantly impacted by the nature and effectiveness of the project management systems used. Digital tools have demonstrated measurable improvements in this area by enabling more accurate forecasting, better tracking of budget deviations, and real-time financial oversight (Oke et al., 2025). However, in contexts where these tools are underutilized, firms often struggle with budget overruns, misallocations of resources, and delays, undermining project profitability and stakeholder satisfaction. Previous studies have addressed elements of digital adoption in construction and engineering firms in Nigeria, yet gaps remain. For instance, Aliu et al. (2025) conducted a comprehensive assessment of technology adoption among heavy-construction firms in Lagos State, identifying AI and cloud computing as key drivers of project success. Similarly, Asenuga et al. (2022) focused on scheduling tools in Southwestern Nigeria but did not explore their relationship with cost control or digital literacy. While these studies contribute valuable insights, they are geographically limited and often fail to address the combined influence of digital literacy, tool usage, and project outcomes.

Statement of the Problem

In today's increasingly digital and competitive construction environment, engineering firms worldwide are leveraging digital project management tools (DPMTs) to enhance productivity, improve cost control, and ensure timely project delivery. These tool are designed to streamline complex project processes through real-time collaboration, automated scheduling, and resource optimization. The central problem this research seeks to address is the limited and inconsistent adoption and utilization of digital project management tools among engineering firms in Enugu metropolis. Preliminary observations suggest that while some firms have adopted DPMTs, their use remains superficial or limited to basic functions, with many employees lacking the digital literacy required to use them effectively. According to Aliu et al. (2025), firms with low digital capacity exhibit weaker project performance metrics compared to those that adopt advanced digital systems. Yet, there is a dearth of empirical data specifically examining these dynamics in Enugu State's engineering sector.

Despite growing interest in construction digitalization, existing studies have largely focused on firms in major commercial hubs such as Lagos and Abuja, leaving a significant knowledge gap regarding smaller but rapidly developing states. Additionally, few studies have examined how digital literacy levels among staff directly influence the practical benefits of DPMT adoption, particularly in relation to project cost control; an area critical to organizational sustainability. If this problem remains unaddressed, engineering firms in Enugu State risk falling further behind in operational efficiency, financial performance, and competitiveness. This research therefore aims to investigate the types of DPMTs in use, assess how employee digital literacy affects tool utilization, and evaluate their impact on cost control. The findings will provide actionable insights to guide digital transformation strategies across the sector.

Aim and Objectives of the Study

The study aims to assess the digital project management tools in Enugu metropolis engineering firms. The specific objectives of the study are to:

i. To identify and categorize the types of digital project management tools currently in use by selected engineering firms in Enugu metropolis.

ii. To assess how employees' digital literacy levels influence the effective use of digital project management tools in selected engineering firms in Enugu metropolis.

iii. To evaluate the relationship between the use of digital project management tools and project cost control outcomes in selected engineering firms in Enugu metropolis.

Research Question

The following research questions are designed to guide the investigation based on the research objectives:

i. What types of digital project management tools are currently being used by selected engineering firms in Enugu metropolis?

ii. How does the digital literacy level of employees affect the effective use of digital project management tools in selected engineering firms in Enugu metropolis?

iii. What is the relationship between the use of digital project management tools and project cost control outcomes in selected engineering firms in Enugu metropolis?

Review of Related Literature

Conceptual Review

Digital Project Management Tools in Engineering Firms

In recent years, the global engineering and construction sectors have witnessed an accelerated shift toward the integration of digital tools into project management processes. These Digital Project Management Tools (DPMTs), which include platforms such as Microsoft Project, Primavera, Asana, Trello, and Building Information Modeling (BIM) systems, are redefining how engineering projects are conceptualized, executed, and evaluated. In the developing countries such as Nigeria where construction inefficiencies, cost overruns, and delivery delays are pervasive, the relevance of these tools becomes particularly acute. As engineering firms strive to meet the demands of a competitive and digitally transforming industry, understanding the nature, adoption, and impact of DPMTs becomes essential to both academic inquiry and industry practice.

At their core, DPMTs facilitate project planning, resource allocation, task tracking, communication, and performance monitoring. They enable collaborative work environments by integrating project data across diverse teams and departments, allowing for greater transparency and responsiveness in decision-making processes. According to Dats and Zahoretska (2024), digital tools such as scheduling software and BIM not only streamline workflows but also contribute to resource optimization, cost reduction, and risk mitigation; key parameters for successful project delivery in the construction industry.

However, despite the recognized advantages of DPMTs, their adoption remains uneven in many developing regions due to institutional, infrastructural, and human capital limitations. In Ghana, for instance, Mustapha et al. (2024) identified low digital readiness, inadequate training, and limited awareness as barriers to effective DPMT integration, especially in risk management and project monitoring functions (Mustapha et al., 2024). Similar challenges have been reported in South Africa, where many firms still rely on basic manual or hybrid systems for managing project tasks, despite recognizing the benefits of full digital adoption (Gogela, Oke & Aigbavboa, 2018). This suggests that while the value proposition of DPMTs is well-understood, implementation lags due to a combination of technical, financial, and organizational factors.

In Nigeria, the digitalization of construction workflows is gaining traction, especially in urban centers, but the depth of tool usage often remains superficial. Engineering firms frequently adopt scheduling tools such as Microsoft Project without fully exploiting advanced features like integrated resource tracking or predictive analytics (Aliu et al., 2025). According to Savina, Malyavkina and Savin (2023), firms adopting only basic functionalities of DPMTs miss out on the broader economic and operational efficiencies that come from integrating these tools into enterprise-wide systems of planning, documentation, and data analysis. Moreover, the lack of structured training and digital literacy among project staff further limits the return on investment in DPMTs.

One conceptual lens useful in understanding the dynamics of DPMT adoption is the Technology–Organization–Environment (TOE) Framework, which posits that technology adoption is influenced by internal organizational capabilities, external market forces, and the attributes of the technology itself. Within this framework, DPMTs represent not just technological tools but also cultural and organizational shifts toward more agile and data-driven project practices. As Patias (2020) argues, the move toward digital twin environments and advanced modeling technologies signifies a transformation not only in tools but also in the strategic orientation of engineering project management. This demands alignment between the technological potential of DPMTs and the strategic vision of firms.

Furthermore, the functionality of DPMTs extends beyond scheduling and cost control; they also support real-time collaboration, documentation, communication, and compliance tracking. As noted by Ekechukwu and Lammers (2019), these tools increasingly aid not only in task coordination but also in leadership functions, such as decision-making, stakeholder engagement, and conflict resolution, especially within large-scale or complex infrastructure

projects. The shift from manual systems to integrated digital environments also implies a redefinition of project roles, where engineers are expected to possess both technical expertise and digital fluency.

Despite the recognized potential of DPMTs, knowledge gaps persist; particularly regarding their contextualized application in medium-sized firms within non-metropolitan regions like Enugu State, Nigeria. While studies by Aliu et al. (2025) and Oke et al. (2025) have provided extensive analyses on digitalization in Nigeria's heavy construction sector, they focus largely on firms in Lagos and Abuja. Enugu, though experiencing infrastructural growth, remains underrepresented in empirical assessments. This underscores the need for localized studies that examine not only which DPMTs are in use, but also how organizational capacity, employee competence, and tool functionality intersect to influence project performance - especially in cost control.

Theoretical Framework

Technology Acceptance Model (TAM)
The Technology Acceptance Model (TAM), proposed by Davis in 1986, is one of the most influential theoretical models used to predict and explain user behavior toward information technology systems. The model originated from the Theory of Reasoned Action (TRA) and was designed to assess why individuals accept or reject new technologies based on specific attitudinal variables (Davis, 1989). Central to TAM are two primary constructs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). These constructs influence users' attitudes toward using technology, their behavioral intentions to use, and ultimately the actual system use.

In the context of engineering firms in Enugu State, TAM provides a conceptual lens through which the adoption and effective utilization of digital project management tools (DPMTs) can be analyzed. As these firms increasingly integrate digital solutions into project workflows, the acceptance and sustained usage of such tools become crucial determinants of operational efficiency and project outcomes. The model's emphasis on perceived usefulness aligns closely with organizational goals related to cost control, time management, and project delivery. These factors are critical performance metrics in engineering practice.

Recent empirical studies affirm the continuing relevance of TAM in explaining technological behaviors in engineering and construction domains. For instance, Shahid et al. (2021) applied TAM to assess how technological alignment and advancement impact project performance, revealing that perceived usefulness significantly mediates the relationship between technological innovations and organizational outcomes. Similarly, Wang and Ding (2023) demonstrated that both PU and PEOU play mediating roles in enhancing knowledge transfer within engineering consulting projects. The study underscored the importance of user-centric digital systems in facilitating organizational knowledge flows.

TAM is particularly valuable for understanding how employee digital literacy affects tool utilization. In engineering environments where staff possess varied levels of technical competence, perceptions of ease of use can either catalyze or hinder technology adoption. Research conducted by Mata et al. (2024) extended TAM by integrating user interface quality and personal innovativeness as predictors of adoption behavior, particularly in architecture and engineering contexts. Their findings revealed that intuitive system designs and user confidence significantly influence behavioral intention to use. Thus the findings offered practical guidance for tailoring digital project management platforms to user needs. In parallel, Gong et al. (2019) examined TAM in the context of Building Information Modeling (BIM) adoption in EPC (Engineering, Procurement, and Construction) projects in China. Their results demonstrated that task-technology fit and organizational support amplify the effects of PU and PEOU, thereby increasing technology uptake among engineering personnel. These insights underscored TAM's utility in evaluating not only individual behavioral intentions but also the broader organizational enablers of digital tool assimilation.

Applying TAM to this study facilitates a structured evaluation of digital project management tools in Enugu State engineering firms by linking employee perceptions to practical outcomes. It enabled an investigation into whether

employees perceive these tools as enhancing their job performance (PU) and whether the systems are sufficiently intuitive (PEOU). Furthermore, TAM supports analysis of how these perceptions correlate with effective usage, cost control, and project delivery; core metrics aligned with the research objectives.

Diffusion of Innovations Theory (DOI)

The Diffusion of Innovations (DOI) Theory, developed by Everett M. Rogers in 1962, is a foundational theoretical model used to understand how new ideas, technologies, or practices spread within and across social systems. The theory posits that diffusion is the process by which an innovation is communicated through specific channels over time among members of a social system (Rogers, 2014). DOI emphasizes four key elements: the innovation itself, communication channels, time, and the social system, all of which interact to determine the rate and extent of adoption. Within the context of digital transformation, particularly in the engineering sector, the DOI framework provides a robust foundation for understanding how digital project management tools (DPMTs) are adopted and institutionalized within organizational routines.

The application of DOI in this study is pertinent, as engineering firms in Enugu State operate within complex technical and organizational environments where adoption of DPMTs is not merely a function of technological availability but also of organizational readiness, cultural fit, and stakeholder engagement. DOI identifies five adopter categories; innovators, early adopters, early majority, late majority, and laggards; which serve to conceptualize the temporal dynamics of technology uptake within firms. These categories facilitate the mapping of how DPMTs propagate among engineering firms and which characteristics influence early or delayed adoption.

Empirical studies in the engineering and construction sectors affirm the utility of DOI in explaining digital technology diffusion. For instance, Shibeika and Harty (2015) employed DOI in a longitudinal case study of a UK-based engineering firm, highlighting how digital innovations such as Building Information Modelling (BIM) diffused non-linearly across departments and were shaped by centralization, standardization, and global integration mechanisms. The authors found that organizational culture and institutional change processes were pivotal to the internal diffusion of innovation, supporting Rogers' claim that diffusion is inherently social and systemic.

In this study, DOI offers a valuable lens for investigating not only the types of DPMTs in use but also the sociocultural and organizational factors that facilitate or hinder their adoption across engineering firms in Enugu State. It enabled the categorization of firms based on their adoption maturity, and it facilitated the identification of systemic enablers such as institutional support, employee digital literacy, peer influence, and communication efficacy. Furthermore, the innovation-decision process outlined by Rogers can be directly mapped onto the stages through which firms transition as they adopt and normalize DPMTs within their operational workflows.

Research Gap

A critical review of existing empirical studies reveals notable progress in understanding the adoption and utilization of digital project management tools (DPMTs) within construction and engineering sectors. However, specific gaps remain that underscore the need for the current study. While several studies, such as those by Adelakun and Akinpelu (2022), and Gbadamosi and Adekunle (2021), have documented the types of digital tools adopted and their benefits, their geographic focus has largely been on Lagos, Abuja, and other regions outside Enugu, with limited exploration of the South-East region.

Additionally, although studies such as Aigbavboa et al. (2023) have established links between digital literacy and tool utilization, they did not contextualize these relationships within local Nigerian engineering firms nor did they assess cost control outcomes in this context. Moreover, Nwankwo et al. (2024) focused on the effectiveness of specific software tools in Enugu, but did not examine how employee digital competence influences broader tool effectiveness or cost outcomes. Thus, there is a lack of localized, integrative research that simultaneously examines the types of DPMTs used, the role of employee digital literacy, and their effect on project cost control in Enugu-based engineering firms. This study addresses this empirical and contextual gap.

Methodology

Research Design

This study adopted a descriptive survey research design. The descriptive survey method is appropriate for systematically obtaining factual and attitudinal data from a specified population without manipulating variables. It enables the researcher to collect quantifiable information regarding existing conditions, opinions, and practices, thereby facilitating the identification of trends, relationships, and patterns within a defined group. In the context of this research, the design was particularly suited to assessing the types and effectiveness of digital project management tools, as well as the influence of employees' digital literacy on their usage within engineering firms in Enugu State. The design also allowed for the evaluation of the relationship between digital tool utilization and project cost control.

Area of Study

Enugu urban is the current capital of Enugu State. It is situated approximately between latitude 06◦ 30 N and longitude 07◦ 30 E. With a land mass of about 72.8 km^2, the area is bound as follows: in the North by Igbo-Etiti and Isi-Uzo Local Government Areas, in the West by Udi Local Government Area, in the South by Awgu and part of Nkanu East Local Government and in the East by Nkanu East Local Government Area. According to the 2006 Nigerian census, the city has a population of 722,664. The capital city's name Enugu was derived from the two Igbo words, Enu Ugwu meaning "hill top" evidencing or testifying to the city's hilly geography.

Sample and Sampling Technique

The study targeted a population of 346 professionals directly involved in project planning, execution, and management functions from five selected engineering and construction-related manufacturing firms in Enugu metropolis. The firms covered under the study are Innoson Group, Ferotex Construction Company Ltd, Techno-Consult Engineering Ltd, KCC Engineering and Construction Ltd, and Dalex Paints. These firms were purposively selected based on their consistent involvement in engineering-driven operations and their known adoption of digital technologies in managing project activities. Using Yamane (1967) method (equation 3.1), the sample size was determined to be 186 experts.

$$n = \frac{N}{1+N(e)^2} \qquad\qquad (3.1)$$

Where:

 n = sample size
N = total population under study
e = error limit (an error limit of 0.05 was used for the study).
Furthermore, the study employed a multi-stage sampling technique to sample the appropriate numbers of experts from each of the five engineering firms under study.

Results and Discussions

Evaluation of the First Objective

The dataset in Table 1 emanated from the survey conducted on the first research question of the study which explored the types of digital project management (PM) tools currently employed by engineering firms within the Enugu metropolis. Analysis of the multiple-response data revealed a diverse adoption landscape with varying degrees of prevalence among tools.

Table 1: Frequency and Percentage Distribution of Responses on Types and Use of Digital Project Management Tools (n = 186)

Item No.	Question / Response Option	Frequency (f)	Percentage (%)
1	Are you aware of any digital project management tools used in your organization?		
	- Yes	168	90.3
	- No	18	9.7
2	Has your organization adopted any digital project management tool?		
	- Yes	153	82.3
	- No	21	11.3
	- Not Sure	12	6.5
3	Which digital PM tools are used in your firm? *(Multiple Response)*		
	- Microsoft Project	110	59.1
	- Primavera P6	76	40.9
	- Trello	54	29.0
	- Asana	42	22.6
	- ClickUp	38	20.4
	- Monday.com	35	18.8
	- BIM	62	33.3
	- Procore	28	15.1
	- Civilsoft	30	16.1
	- Planswift	25	13.4
	- Others (specify)	12	6.5
4	How long has your organization used these tools?		
	- Less than 1 year	21	11.3
	- 1–3 years	84	45.2
	- 4–6 years	52	28.0
	- More than 6 years	29	15.6

Item No.	Question / Response Option	Frequency (f)	Percentage (%)
5	Project functions tools are used for *(Multiple Response)*		
	- Project Scheduling	134	72.0
	- Resource Allocation	112	60.2
	- Budgeting and Cost Control	108	58.1
	- Communication and Collaboration	121	65.1
	- Monitoring and Reporting	116	62.4
	- Risk Management	79	42.5
	- Document Management	91	48.9
	- Others (specify)	14	7.5
6	Frequency of tool usage		
	- Daily	68	36.6
	- Weekly	74	39.8
	- Occasionally	32	17.2
	- Rarely	9	4.8
	- Never	3	1.6
7	Who primarily uses these tools? *(Multiple Response)*		
	- Project Managers	138	74.2
	- Site Engineers	106	57.0
	- ICT Personnel	84	45.2
	- Procurement Officers	47	25.3
	- Admin Staff	39	21.0
	- Others (specify)	10	5.4
8	Overall effectiveness of digital tools		
	- Very Effective	51	27.4
	- Effective	88	47.3
	- Moderately Effective	33	17.7
	- Ineffective	10	5.4
	- Very Ineffective	4	2.2
9	Main advantages of using tools *(Multiple Response)*		
	- Improved Communication	129	69.4
	- Better Time Management	118	63.4
	- Enhanced Cost Control	104	55.9
	- Improved Task Coordination	112	60.2
	- Easier Monitoring and Evaluation	121	65.1
	- Others (specify)	11	5.9
10	Challenges in using tools *(Multiple Response)*		
	- Lack of Skilled Personnel	93	50.0
	- Poor Internet Access	76	40.9
	- High License/Subscription Cost	81	43.5
	- Resistance to Change	67	36.0
	- Limited Management Support	72	38.7
	- Inadequate Training	84	45.2

Source: Researchers' computation from Field Survey Data, 2025

The most widely used digital PM tool is Microsoft Project, cited by 59.1 percent of respondents. This dominance suggests its entrenched status as an industry-standard software, likely due to its comprehensive scheduling and cost-tracking capabilities. Following this, Primavera P6 was reported by 40.9 percent of participants, reflecting its strong presence in firms involved in large-scale or complex engineering projects, where high-level scheduling and resource management are critical.

Tools such as BIM (33.3 percent) and Trello (29.0 percent) also demonstrate significant uptake, indicating a trend toward collaborative and model-based planning environments. Mid-tier adoption rates were observed for Asana (22.6 percent), ClickUp (20.4 percent), and Monday.com (18.8 percent) - platforms known for their user-friendly interfaces and suitability for agile or hybrid project teams. Meanwhile, specialized tools like Civilsoft (16.1 percent), Procore (15.1 percent), and Planswift (13.4 percent) were adopted at lower rates, likely due to their niche functions in cost estimation, field productivity, or construction-specific workflows.
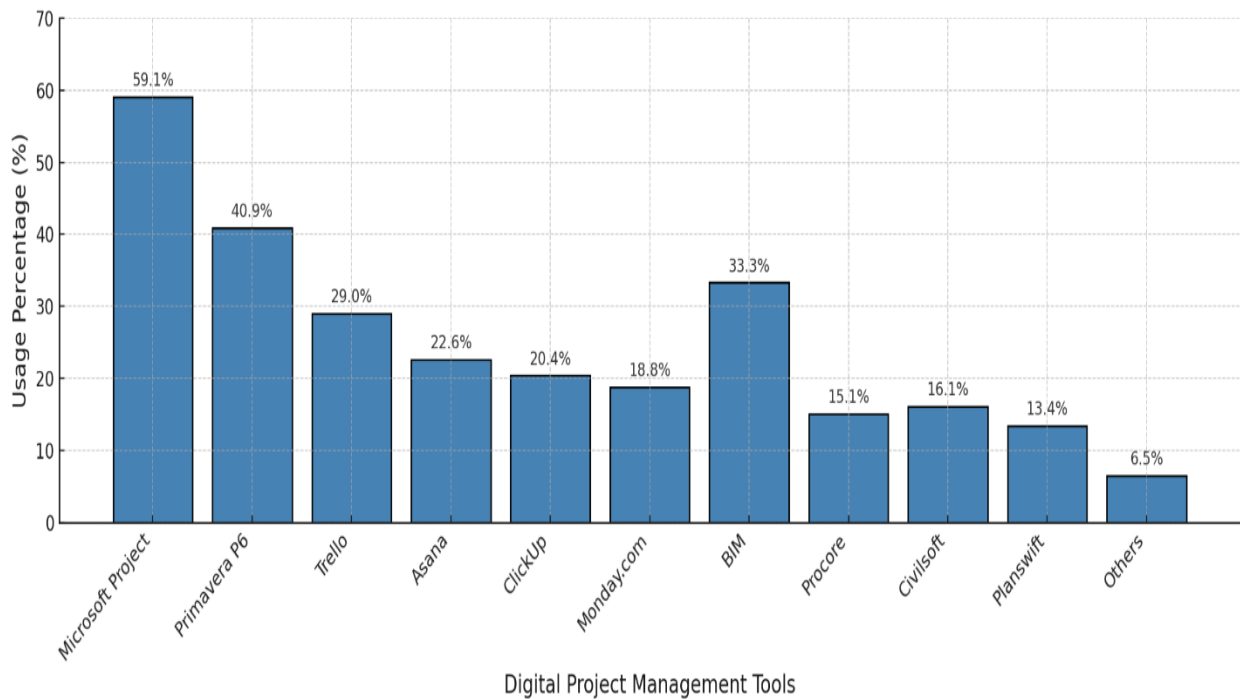

Figure 1: Distribution of digital PM tools used by the selected firms in Enugu metropolis

Notably, only 6.5 percent of respondents referenced "Other" tools, suggesting that while diversity exists, most firms rely on a relatively consistent core group of platforms. The distribution, as visualized in Figure 4.1, clearly illustrates Microsoft Project's leading role, alongside the varied but structured ecosystem of digital PM tools in use.

Evaluation of the Second Research Question

The analysis of result regarding the influence of digital literacy on the effective utilization of digital project management tools is presented in Table 2. The results, expressed in terms of mean scores, standard deviation, and percentage distribution, revealed a consistently strong agreement across all measured statements.

Table 2: Statistical analysis of how employees' digital literacy levels influence the effective use of digital project management tools in selected engineering firms in Enugu metropolis.

No.	Statement	SA	A	U	D	SD	Mean	Std.
1	High digital literacy levels enhance accuracy in the use of digital project management tools.	152 (81.7%)	32 (17.2%)	1 (0.5%)	1 (0.5%)	0 (0.0%)	4.80	0.45
2	Lack of digital competence reduces the efficiency of digital project management tool application.	107 (57.5%)	73 (39.2%)	4 (2.2%)	1 (0.5%)	1 (0.5%)	4.52	0.63
3	Advanced digital skills improve the ability to use project management tools for task tracking and updates.	127 (68.3%)	55 (29.6%)	3 (1.6%)	1 (0.5%)	0 (0.0%)	4.65	0.54
4	Digital illiteracy leads to frequent misuse or underutilization of project management tool features.	118 (63.4%)	64 (34.4%)	3 (1.6%)	1 (0.5%)	0 (0.0%)	4.60	0.55
5	Effective navigation of digital project tools is dependent on adequate digital training.	156 (83.9%)	28 (15.1%)	1 (0.5%)	1 (0.5%)	0 (0.0%)	4.82	0.44
6	The level of digital literacy among staff influences the consistency of digital tool usage across projects.	98 (52.7%)	80 (43.0%)	6 (3.2%)	1 (0.5%)	1 (0.5%)	4.46	0.64
	Grand mean/ Standard deviation						4.64	0.42

Source: Researchers' computation from Field Survey Data, 2025

This strong agreement is evidenced by the high grand mean of 4.64 and a relatively low standard deviation of 0.42. This indicates overall consensus among respondents on the critical role of digital literacy in project management tool effectiveness. The statement assessing whether effective navigation of digital tools is dependent on adequate digital training recorded the highest mean score of 4.82 with a standard deviation of 0.44. This item also had the highest percentage of Strongly Agree responses at 83.9 percent, underscoring the perceived importance of structured digital training for ensuring competent use of project tools.

Conversely, the item evaluating whether digital literacy influences consistency of tool usage across projects recorded the lowest mean score of 4.46 and the highest standard deviation of 0.64, suggesting slightly more variability in respondent views. Despite this, the agreement level remains strong, with 52.7 percent strongly agreeing and 43 percent agreeing. Other statements, such as those relating to the impact of digital competence on efficiency and the consequences of digital illiteracy, recorded similarly high mean values between 4.52 and 4.65. These results collectively point to a strong perceived link between digital skills and accurate, consistent, and efficient use of project management tools.

Analysis of the Third Objective

The results of the third research question, which explored how the use of digital project management tools influences project cost control outcomes are shown in Table 3. The responses, analyzed through their mean scores, standard deviations, and percentage distributions, consistently supported the proposition that digital tools significantly enhance cost management effectiveness in engineering projects.

Table 3: The relationship between the use of digital project management tools and project cost control outcomes in selected engineering firms in Enugu metropolis.

No.	Questionnaire Item	SA	A	U	D	SD	Mean	Std.
1	The use of digital project management tools enhances accuracy in tracking project expenses.	144 (77.4%)	39 (21.0%)	2 (1.1%)	1 (0.5%)	0 (0.0%)	4.75	0.49
2	Implementation of digital project management tools reduces instances of budget overruns.	107 (57.5%)	73 (39.2%)	4 (2.2%)	1 (0.5%)	1 (0.5%)	4.52	0.63
3	Cost estimation during project planning is more precise when digital tools are utilized.	138 (74.2%)	44 (23.7%)	3 (1.6%)	1 (0.5%)	0 (0.0%)	4.71	0.52
4	Digital tools facilitate timely adjustments to project costs based on real-time data.	93 (50.0%)	82 (44.1%)	9 (4.8%)	1 (0.5%)	1 (0.5%)	4.42	0.66
5	Project managers achieve better control over procurement expenses using digital management tools.	76 (40.9%)	88 (47.3%)	19 (10.2%)	2 (1.1%)	1 (0.5%)	4.26	0.73
6	Integration of digital tools improves cost accountability across various project phases.	156 (83.9%)	28 (15.1%)	1 (0.5%)	1 (0.5%)	0 (0.0%)	4.82	0.44
	Grand mean/ Standard deviation						4.58	0.45

Source: Researchers' computation from Field Survey Data, 2025

The statement indicating that the integration of digital tools improves cost accountability across various project phases yielded the highest mean score of 4.82, accompanied by a low standard deviation of 0.44. This suggests a strong consensus among respondents on the accountability benefits of digital tools, as further emphasized by 83.9 percent of participants selecting Strongly Agree.

Similarly, the notion that digital tools enhance accuracy in tracking project expenses also received strong support, with a mean of 4.75 and a standard deviation of 0.49. A comparable level of affirmation was observed for the precision of cost estimation during planning, which scored a mean of 4.71. These responses affirm the critical role of digital project tools in both real-time expense monitoring and early-stage budgeting. The item with the lowest mean score, 4.26, addressed the use of digital tools for controlling procurement expenses. Despite being the lowest, this score still indicates agreement, though the relatively higher standard deviation of 0.73 implies more variability in opinion. The grand mean of 4.58 and a standard deviation of 0.45 confirm a strong, positive perception that digital project management tools play an essential role in achieving cost efficiency, minimizing overruns, and supporting accurate financial planning across project lifecycles.

Discussion of Results

The findings of this study revealed a diverse landscape of digital project management tool adoption among engineering firms in Enugu metropolis. Microsoft Project emerged as the most widely utilized tool, followed by Primavera P6, BIM, Trello, and Asana. These results align significantly with previous empirical studies conducted in other Nigerian contexts. For instance, Adelakun and Akinpelu (2022) identified Microsoft Project and Primavera as dominant tools among firms in Lagos and Abuja, which corroborates the present study's evidence of their prevalence in Enugu. Similarly, Gbadamosi and Adekunle (2021) observed increased integration of cloud-based platforms such as BIM and Trello. The study highlighted a trend consistent with tool usage patterns uncovered in this study.

The current findings also support the conclusions of Okeke and Chukwuma (2022), who noted a growing interest in modern tools like ClickUp and Monday.com, especially among digitally literate firms in the South-East, including Enugu. This similarity underscores a regional convergence in digital transformation trends. Additionally, Olowu et al. (2023) confirmed the increasing popularity of mobile-enabled platforms such as Procore and PlanGrid, a finding echoed by the moderate usage rates of mobile-compatible tools reported in this study. Interestingly, the results also diverge from those of Nwankwo, Eze and Okafor (2024), who found Civilsoft and Planswift to be highly influential in improving cost outcomes within Enugu's building sector. In the present study, although these tools were recognized, their usage was less pronounced, possibly due to sector-specific preferences or functional limitations outside cost estimation.

The findings from this study also demonstrated a clear and positive relationship between employees' digital literacy levels and the effective use of digital project management tools within engineering firms in Enugu metropolis. Respondents with higher digital competence consistently reported greater ease in navigating software features, integrating project data, and collaborating with team members through digital platforms. This observation is strongly supported by the study of Aigbavboa et al. (2023), which established that digital proficiency among construction professionals enhanced tool utilization and project efficiency. Similarly, Issa et al. (2021) highlighted the critical role of digital competency frameworks in promoting effective project delivery through digital tools.

The findings also echo those of Olawale and Sunmola (2022), who observed that low digital literacy inhibited the adoption and functional use of tools such as BIM and Primavera, resulting in suboptimal project outcomes. This pattern is similarly reflected in the present study, where participants with limited technical skills reported frequent difficulties in operating advanced features or applying the tools consistently across project stages. Moreover, the study aligns with Opoku et al. (2022), who found that digital skills directly influenced innovative tool use, particularly in communication, scheduling, and real-time reporting.

Additionally, the study reinforces insights from Nikou et al. (2022), who emphasized that digital and information literacy significantly shape technology acceptance, especially perceptions of ease of use. This complements the present findings, where those with higher digital exposure demonstrated a more seamless adaptation to various project management software. Furthermore, the results correspond with the conceptual assertions of Suprun et al. (2019), who identified a persistent digital skills gap among engineers entering the workforce, often resulting in inefficient tool use. Zulu et al. (2023) further support this by illustrating how individual characteristics, including digital aptitude and learning disposition, influence tool performance in project contexts.

Collectively, the findings affirm that digital literacy is not only a technical requirement but also a strategic enabler of project tool effectiveness. This revelation underscores the need for ongoing training and capacity development within engineering firms in Enugu.

The study also established a strong positive relationship between the use of digital project management tools and the attainment of effective project cost control outcomes among engineering firms in Enugu metropolis. Respondents indicated that digital tools improved budgeting accuracy, enhanced real-time cost tracking, and facilitated early detection of cost overruns. These observations align with the conclusions of Okeke and Chukwuma

(2022), who found that firms using platforms such as Microsoft Project and Primavera P6 experienced improved cost control and financial transparency. Similarly, Olowu et al. (2023) reported that digital tools, particularly those with mobile and cloud integration, enabled better cost monitoring on-site and during remote project coordination.

However, the findings contrast slightly with those of Nwankwo, Eze and Okafor (2024), who emphasized the dominance of cost estimation software like Civilsoft and Planswift. In the present study, while such tools were acknowledged, respondents emphasized integrated platforms over standalone estimators. This result reflects a broader preference for multifunctional digital solutions that combine scheduling, communication, and cost control. Furthermore, Suprun et al. (2019) and Yang (2020) both emphasized that digital tools only produce cost-related benefits when properly embedded into workflow processes and used by competent personnel. This point is reaffirmed by the findings of this study; linking digital literacy with cost control efficiency.

Conclusion

This study assessed the use of digital project management tools among selected engineering firms in Enugu metropolis, with particular focus on the types of tools adopted, the role of employee digital literacy, and the implications for project cost control. The findings provide a comprehensive understanding of how digital technologies are integrated into project workflows within the engineering sector in a developing regional context. The investigation into the types of digital project management tools revealed a notable level of technological adoption across the surveyed firms. Tools such as Microsoft Project, Primavera P6, and BIM were among the most widely used, reflecting a gradual shift from traditional project management approaches to more digitized systems. However, the coexistence of both advanced and basic platforms suggests that adoption remains uneven, likely influenced by project scale, organizational capacity, and digital maturity.

The study also established that employee digital literacy significantly impacts the effective use of these tools. Firms with a digitally competent workforce demonstrated greater efficiency, accuracy, and consistency in tool utilization. This underscores the strategic importance of digital skill development as a prerequisite for realizing the full potential of project management technologies. Furthermore, the findings confirmed a strong positive relationship between the use of digital project management tools and improved cost control outcomes. Digital platforms supported timely budgeting, expenditure tracking, and procurement management, contributing to better financial discipline and accountability throughout the project lifecycle. These results suggest that the integration of digital tools is not only a matter of operational convenience but a critical driver of project performance and cost efficiency.

Recommendations

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

i. Engineering firms should invest in regular digital skills training for employees to improve their digital literacy and ensure more effective use of project management tools.

ii. Firms should adopt and standardize suitable digital project management tools such as Microsoft Project and Primavera P6 that align with the size and complexity of their projects.

iii. Management should integrate digital project management tools into cost control practices to enhance project budgeting, monitoring, and overall cost efficiency.

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