Technologique | 2026, Vol. 7, No.1, 210 – 224 | ISSN Online: 3028-1415 | ISSN Print: 3028-1407
DOI: https://doi.org/10.62718/vmca.tech-gjtdsi.7.1.SC-0326-007

OPEN ACCESS

Utilization of Optimized Process Software for the Quantity Estimation Standardization in Building Projects of DPWH Laguna: An Impact Study

Article History:

Initial submission:	11 March 2025
First decision:	15 March 2025
Revision received:	30 March 2026
Accepted for publication:	05 April 2026
Online release:	14 April 2026

Nemielyn A. Fadul, ORCID No. 0009-0000-7203-3563

Master of Science in Construction Management, Polytechnic University of the Philippines, Sta. Mesa, Manila, Philippines

Abstract

Quantity estimation is a critical component of construction project planning, particularly in public-sector building projects, where accuracy, efficiency, and transparency are essential. In the Department of Public Works and Highways (DPWH), quantity estimation supports cost and scope determination and project approval. Despite generally acceptable performance, inefficiencies persist due to the absence of standardized digital workflows and the adoption of optimized process software for estimation. This study assessed the impact of quantity estimation practices on DPWH Engineering Districts' building projects in Laguna. It examined the relationship between respondents' profiles and the extent of impact on project scope, cost accuracy, and time. A descriptive research design was employed using survey questionnaires administered to licensed civil engineers in the Planning Section of DPWH. Descriptive statistics and Spearman's rho correlation were used for data analysis. Findings show that current practices are adequate but can be improved in terms of efficiency, consistency, and workflow integration. A significant relationship between estimation practices and project planning effectiveness was identified. A Quantity Estimation Standardization Plan was developed to support improved planning performance in public infrastructure projects.

Keywords: digital workflow standardization, quantity estimation, estimation software adoption, dpwh engineering districts, public infrastructure

INTRODUCTION

Modernization in the construction industry has shifted from traditional procurement and equipment to advanced digital planning, yet the construction estimate remains a projection prone to rapid industry fluctuations (Landau, 2022). As a critical managerial control mechanism, the precision and timeliness of an estimate, which involves determining project budgets and material quantities, directly impact performance indicators such as cost control, schedule delays, and potential variation orders (Ramadhan & Waty, 2025). Despite the evolution of software that delivers accurate results in a fraction of the time compared to manual methods, many traditional processes remain time-intensive and susceptible to human errors that can result in substantial financial losses (Breitmeyer, 2018). While some private institutions have successfully transitioned to Building Information Modeling (BIM) to integrate intelligent data from planning through completion, government entities are only beginning to consider abandoning outdated practices in favor of such modernization.

The Department of Public Works and Highways (DPWH) serves as the primary engineering arm of the Philippine government, maintaining ISO 9001:2015 certification since May 2022 to ensure international standards of reliability and quality in public infrastructure. However, technological adoption remains uncommon in certain areas, such as the Laguna District, where engineers still rely on semi-automated or manual estimation processes for complex tasks ranging from earthworks to finishing. This reliance on non-standardized formats often leads to backlogs and inaccuracies, making estimation one of the most tedious tasks for planning engineers. Consequently, there is a pressing need to analyze how implementing optimized process software can standardize

quantity estimation within these districts to address challenges related to accuracy, efficiency, and transparency while improving overall workflow and cost management.

This research aims to demonstrate how software-based optimization can transform public sector construction management by providing evidence that digital tools minimize error and accelerate project delivery. By evaluating existing practices and proposing strategies for sustainable integration, the study supports the DPWH Laguna in formulating policies and training programs that align with the department's modernization goals. Furthermore, the findings contribute to the broader academic field by serving as a reference for digital transformation and process optimization within the construction sectors of developing countries. Ultimately, the shift toward standardized, technology-driven estimation practices is presented as an essential step for government institutions to enhance operational effectiveness and deliver infrastructure that is more responsive to the needs of the public.

LITERATURE REVIEW

Quantity Estimation Practice in the Department of Public Works and Highways (DPWH). The DPWH estimation framework is anchored in standardized formats for the Program of Works (POW) and Approved Budget for the Contract (ABC), as established by Department Orders No. 137 (2017) and No. 28 (2019). While these orders ensure documentation uniformity across regional and district offices, they function as templates rather than computational manuals, leaving the technical process of quantity take-off largely to manual extraction from 2D AutoCAD plans and encoding into Excel spreadsheets (DPWH, 2017; DPWH, 2019; DPWH, 2025). This hierarchical and manual structure, while aligned with national budgeting protocols and quarterly Construction Materials Price Data (CMPD) updates, creates significant procedural constraints. The lack of an integrated digital platform makes version tracking and cross-phase consistency difficult, situating DPWH operations within what the World Bank (2023) describes as "fragmented digital ecosystems" where unlinked data sources hinder overall workflow efficiency.

Despite the institutional baseline for public works, a stark digital gap exists between government practices and the private sector, where the adoption of Building Information Modeling (BIM) and optimized software has already led to faster revisions and reduced errors (Dela Cruz et al., 2022). In district offices like DPWH Laguna, the reliance on manual coordination for every design or cost update leads to frequent delays in estimate preparation and approval, as each revision must be manually revalidated to ensure compliance. Although recent initiatives, such as the 2025 launch of an online contractor transaction platform, signal a move toward digital governance, these efforts remain peripheral to the core estimation workflow (Rosel, 2025; Villaseñor, 2024). Ultimately, transitioning to optimized process software requires more than just technology; it demands a procedural restructuring and targeted personnel training to overcome the redundancies and inefficiencies inherent in the current manual system (World Bank, 2023).

Software for Construction Estimate. Construction estimating is a fundamental stage in every project, requiring general builders and contractors to prepare detailed cost estimates, schedules, and blueprints to gauge total expenditures accurately (Stromberg, 2022). Modern software solutions, ranging from cloud-based platforms to local desktop installations, greatly facilitate the development of material and labor estimates, offering significant time savings over traditional manual methods. While pricing models vary based on the number of users and specific features, with monthly costs typically ranging from $30 to $250 per estimator, the investment is often minimal compared to the overall cost of construction. Leading industry tools include STACK for takeoff, ProEst as a comprehensive overall solution, and specialized options like Sage Estimating for large firms or Clear Estimates

for small contractors (Stromberg, 2022). Advanced civil engineering projects further integrate software like AutoCAD for blueprinting and ETABS for structural evaluation, often culminating in the use of Autodesk Revit, which is recognized as a sophisticated and user-friendly 3D modeling application that can automatically generate material estimates for steel and concrete (Siddiqui et al., 2017).

Building Information Modeling (BIM) has become an essential tool for improving accuracy by combining three-dimensional models with time and cost details, allowing design changes to trigger automatic budget adjustments (Jiang & Xu, 2024). Research indicates that BIM can reduce the time required to generate estimates by 80% and lower construction costs by 10% through clash detection (Metkari et al., 2015), while 5D BIM tools specifically enhance the accuracy of quantity takeoffs for better cash flow management (Pishdad & Onungwa, 2024; Alathamneh et al., 2024). Similarly, digital takeoff software like PlanSwift offers a distinct advantage over traditional Microsoft Excel spreadsheets by significantly reducing the heavy workload and potential for human error (Varma et al., 2016). By allowing estimators to upload drawings and mark boundaries for immediate area calculation, PlanSwift can reduce the time required for a takeoff from 15 hours down to just seven, ensuring that accuracy is maintained even when managed by less experienced staff (Varma et al., 2016).

Software Adoption Barriers. One major barrier to adopting optimized process software for quantity estimation is the substantial cost associated with implementation and maintenance, including licensing fees, hardware upgrades, and continuous training. These financial requirements pose a significant challenge for district-level offices that must operate within fixed government budgets, as cost and procurement constraints remain primary factors delaying digital adoption in construction management (Business Research Insights, 2025). Furthermore, the lack of integration with existing manual systems creates technical friction, as many DPWH district offices still depend on isolated spreadsheet-based computations and separate databases. Transitioning to integrated software often necessitates a complex process of data restructuring and revalidation, which can inadvertently slow down operations or create redundant, duplicate workflows if the migration is not managed with precision (PMarketResearch, 2025).

Human and organizational factors also play a critical role in the success of software implementation, as engineers accustomed to traditional methods may exhibit resistance due to limited exposure or skepticism regarding the accuracy of automated results. Building confidence in digital platforms requires a focus on readiness, comprehensive training, and consistent technical support (Gowthaman et al., 2025). Additionally, achieving true standardization remains a technical hurdle; without unified cost libraries and synchronized workflows, estimation outputs may continue to vary across different projects even when utilizing the same software tools. To ensure that optimized process software effectively enhances accuracy, consistency, and transparency, it is essential for the DPWH to address these barriers through structured training programs, deliberate software integration planning, and the establishment of standardized data frameworks.

Standardization of Quantity Estimates: Global Models – RICS, PICQS, and Related Frameworks. Global professional frameworks such as those developed by the Royal Institution of Chartered Surveyors (RICS) and the Philippine Institute of Certified Quantity Surveyors (PICQS) serve as benchmarks for standardizing quantity surveying and cost estimation practices. RICS' cost prediction and professional standards emphasize accuracy, consistency, and transparency in cost forecasting while promoting the use of the International Construction Measurement Standards (ICMS) to harmonize measurement systems across countries. These frameworks

advocate for unified methods that ensure comparability and accountability in construction projects (RICS, 2024). Having said that, PICQS adapts these global principles in the Philippine context by promoting ethics, competency, digitalization, and continuous professional development among local quantity surveyors. Its collaboration with RICS (2024) strengthens local alignment with international standards and fosters the integration of digital tools in cost management. Through these initiatives, PICQS contributes to elevating the technical and ethical standards of the profession and encourages the adoption of consistent, transparent, and technology-driven estimation methodologies across both the private and government sectors (PICQS, 2025).

Impact on Public Works and Infrastructure Quality. Integrating international standards into public infrastructure projects can significantly bolster cost reliability and project outcomes by reducing discrepancies and budget deviations through standardized measurement and enhanced transparency. While certification from professional organizations like PICQS remains an individual choice rather than a compulsory requirement within the DPWH, adopting practices inspired by RICS and PICQS such as consistent documentation formats and ethical guidelines strengthens project accountability and professionalizes estimation at the district level. This alignment with global frameworks ensures that estimates are technically sound and auditable, mirroring international trends where professional standards are increasingly integrated with digital systems to achieve superior accuracy and efficiency (RICS, 2024). Ultimately, harmonizing DPWH's estimation practices with these global quantity surveying frameworks supports the broader goal of standardization, directly influencing the professional consistency and credibility of public infrastructure delivery in the Philippines.

Impact of Utilization of Optimized Process Software for Quantity Estimation. The integration of optimized process software for quantity estimation has significantly enhanced accuracy, efficiency, and transparency across both the government and private sectors, with market studies indicating a reduction in preparation time by up to 50% (Business Research Insights, 2025). Within agencies like the DPWH districts in Laguna, these tools foster greater accountability by enabling systematic tracking of revisions and data inputs, ensuring that internal audit trails and version control reduce errors during the validation process (IntoAEC, 2025). As the estimator's role shifts from manual computation toward high-level data analysis and oversight, success relies heavily on structured personnel training and the effective management of organizational change (Ramadan & Nassereddine, 2023). Ultimately, by synchronizing software with existing procedures and standardizing data frameworks, government agencies can achieve stronger alignment with professional and regulatory standards while maintaining more consistent and traceable infrastructure records.

Theoretical Framework. This study is anchored on three complementary theories: the Theory of Constraints (TOC), the Project Management Triangle, and the Diffusion of Innovations Theory. According to Goldratt (1984), TOC posits that identifying and improving a single process hindering an organization's potential, such as the manual estimation procedures in the DPWH planning phase, is the key to greater success. This manual bottleneck is bound by the Project Management Triangle, or "Iron Triangle," which asserts that project quality is a balance of budget, time, and scope; inefficiencies in quantifying materials consume considerable time, lead to backlogs, and ultimately impact the final budget and project quality (PMI, 2017; Hussain, et al., 2021). While Rogers (2003) emphasizes through the Diffusion of Innovations that adopting new technology is a gradual process influenced by organizational context and personnel competencies, the theory suggests that early adoption facilitates collaborative knowledge exchange and eventual institutionalization. By implementing optimized process software to automate repetitive tasks with uniform standards, the agency can improve its "throughput," defined here as the consistent,

reliable, and faster generation of quantity estimates, thereby resolving the primary constraint within the DPWH Laguna framework.

Conceptual Framework. Figure 1 shows the conceptual framework of the study. The study's input includes responses from DPWH Laguna engineers, classified by demographic profile (engineering district, age, sex, educational attainment, and years of service in the planning section). Moreover, the current status of estimation in DPWH Laguna District Office building projects will be analyzed with respect to the estimate type and estimating software used, the duration of estimate completion, the availability of resources, and the challenges in the existing system. The perception of planning section engineers regarding the impact of quantity estimation on a district construction project's scope, cost, and time will also be included. Information on awareness and readiness to adopt an optimized process software will also be looked at.

The framework process includes the stages undertaken in conducting the study. Data gathering through the distribution and collection of online survey questionnaires among planning engineers or estimators. Organizing data and assessment of the level of impact on quantity estimation in districts' building projects in which survey data has been gathered. Following the evaluation of the findings, conclusions and recommendations were formulated.

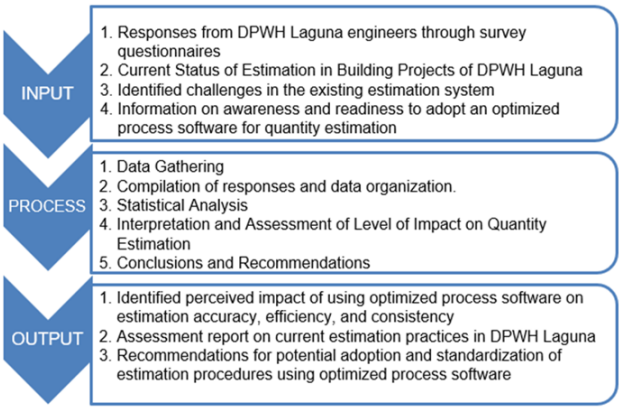

Figure 1
Conceptual Framework of the Study

The study's output includes the level of impact on accuracy, efficiency, and transparency when using optimized process software for quantity estimation of building projects in DPWH Laguna District Offices, alongside an assessment report on the current estimation process. Furthermore, the recommendation to adopt the quantity estimation standardization plan will be finalized and presented.

The reviewed literature collectively supports the evidence that process optimization and digital transformation enhance estimation reliability and operational transparency. The integration of optimized software into DPWH estimation practices aligns with global models that emphasize consistency, accountability, and digital innovation.

Despite this, current research still reveals significant gaps in the digital transformation of public infrastructure, particularly within DPWH district offices where estimation remains largely manual compared to the more digitally integrated private sector. A primary disconnect exists between international professional standards, such as those from PICQS and RICS, and the DPWH's internal cost manuals, which currently prioritize procedural compliance over the benefits of harmonized certification. Furthermore, there is a lack of empirical evidence quantifying how optimized process software specifically impacts measurable outcomes like estimation time, accuracy, and transparency within a government setting. Addressing these institutional and academic gaps is essential for guiding future policy and successfully navigating the strict audit constraints inherent in public-sector digitalization.

With this, the study aims to determine the extent of the impact of quantity estimation in DPWH Engineering District Laguna's building projects and to develop a Quantity Estimation Standardization Plan. Specifically, it seeks to answer the following questions:

1. What is the demographic profile of respondents in terms of:

1.1 Engineering District;
1.2 Age;
1.3 Sex;
1.4 Educational Attainment; and,
1.5 Years of Service in Planning Section?

2. What is the current status of estimation in building projects of DPWH Laguna in terms of:
   2.1 Estimate type used;
   2.2 Estimate Software used;
   2.3 Duration for Estimate Completion; and,
   2.4 Resource Availability?

3. What is the impact of the quantity estimation in a district building construction project in terms of:
   3.1 Scope;
   3.2 Cost Accuracy; and,
   3.3 Time?

4. Is there a significant relationship between the respondents' profiles and the extent of impact of quantity estimation?

5. What Quantity Estimation Standardization Plan can be developed for the use in a district building construction project?

Hypotheses. At 0.5 level of significance, the following hypotheses were tested. These hypotheses were formulated based on the problem statement and are intended to determine whether the quantity estimation standardization plan has a measurable impact on the effectiveness of project planning:

Ho: There is no significant relationship between the quantity estimation standardization plan and the effectiveness of project planning.

Ha: There is a significant relationship between the quantity estimation standardization plan and the effectiveness of project planning.

METHODS

Research Design. The research employed a quantitative methodological design, which was deemed the most appropriate approach for addressing the objectives of the study. Quantitative methods are particularly suited for systematically collecting and analyzing numerical data, thereby enabling the identification of patterns of agreement and divergence among respondents. This design facilitates the examination of relationships between selected variables in a structured and objective manner, without requiring manipulation of the natural study environment. By relying on statistical analysis, the methodology ensures that findings are both measurable and replicable, thereby enhancing the validity and reliability of the conclusions drawn.

Population and Sampling. A purposive sampling method was used in this study, with the aim of selecting engineers directly involved in the preparation, review, and validation of quantity estimates for building projects. Each member of the population selected was acknowledged as a reliable source for gathering information. The respondents met the required or relevant profile essential to the objectives of the study.

Ninety-five percent (95%) confidence level and 5% margin of error were used; therefore, 50 respondents were obtained on the calculation, but due to some limitations, only 45 individuals from the Planning Section of DPWH Laguna 1st, 2nd, and 3rd Engineering Districts have actually participated to provide their insights and answers. These individuals were interviewed at the Planning Section of the DPWH Laguna District Offices. They were selected for this study because they are exceedingly experienced and credible on this matter, which is fundamental for producing comprehensive and coherent results essential for developing a standardization plan.

Instrumentation. Data were collected using a structured survey that aligns with the quantitative research style. The instrument consisted of two parts: (1) the respondent's profile and (2) statements measuring the perceived impact of quantity estimation practices and software utilization using a Likert-scale format. The questionnaire was

designed to capture professional perceptions of accuracy, efficiency, transparency, and standardization.

Data Gathering Procedure. Social Media platforms and digital communication tools, including messaging applications, email, and Google Drive, were used as data-gathering media. These platforms facilitated the efficient distribution and retrieval of survey instruments, enabling the timely consolidation of responses and supporting the comprehensive analysis and synthesis of findings for discussion.

Data Analysis. In this study, the data were reviewed and interpreted using a perception-based assessment of the impact on each research question. The impact of using optimized process software for quantity estimation is measured through respondents' professional judgments and experiences, as reflected in their levels of agreement with operational indicators of efficiency, accuracy, transparency, and standardization. As a support and to clearly understand the responses gathered from the participants, basic descriptive statistics such as frequency, percentage, mean, and standard deviation were used to summarize the respondents' demographic profile and their level of agreement with the survey items.

To examine whether the respondents' background has any connection to how they view quantity estimation and standardization, Spearman's Rank-Order Correlation Coefficient (Spearman's Rho) was used. This test was selected because the profile variables and the rating scale responses are both organized in rank or categories. Spearman's Rho is suitable for this type of data and helps identify meaningful relationships between variables rather than differences.

RESULTS

Demographic profile of the respondents. Table 1 presents the demographic profile, indicating that the respondents are primarily early to mid-career planning engineers with direct involvement in quantity estimation activities. The balanced distribution across the three engineering districts ensures that the findings reflect organizational-level practices rather than district-specific conditions. Meanwhile, the mix of tenure and educational attainment suggests that perceptions are shaped by both practical experience and formal technical training, providing a reliable basis for assessing current estimation practices within DPWH Laguna.

Table 1
Demographic Profile of Respondents in terms of the Engineering District

Engineering District	f	%
Laguna I	15	33.30
Laguna II	15	33.30
Laguna III	15	33.30
Total	45	100.00
Age Group		
21-25 years old	7	15.60
26-30 years old	26	57.80
31 years and above	12	26.70
Total	45	100.00
Sex		
Male	25	55.56
Female	20	44.44
Total	45	100.00
Educational Attainment		
Bachelor's Degree	40	88.90
Master's Degree	5	11.10
Total	45	100.00
Years of Service		
5 years	25	55.60
6-10 years	15	33.30
10 years	5	11.10
Total	45	100.00

Current status of estimation in building projects of DPWH Laguna. Table 2 provides insights into the current status of estimation in terms of the estimate type used. The result suggests that the majority of respondents perceived significant areas for enhancement in the current estimation practices. It shows that the majority of respondents strongly believe that there are

areas that can be improved in the estimate type used. Moreover, a literature on construction estimation also stresses that widely used tools like Excel and manual procedures, despite familiarity, are prone to errors and inefficiencies when compared to more advanced estimating software (Nomitech, 2023).

Table 2
Current Status of Estimation in terms of Estimate Type Used

Item Statement	M	SD	Interpretation
There are aspects of our current estimation methods (Excel, AutoCAD, or manual procedures) that still need improvement	4.29	0.626	Strongly Agree
Overall Mean	**4.29**		**Strongly Agree**

This reinforces the insight that the current estimation setup is perceived by the respondents as functional yet insufficient, requiring updates or improvements to better support accuracy and efficiency of overall project delivery.

Table 3
Current Status of Estimation in terms of Estimate Software Used

Item Statement	M	SD	Interpretation
I get very minimal corrections when using Microsoft Excel, AutoCad as software for building project estimates.	4.04	0.520	Agree
I need to re-check my work several times before final approval.	3.93	0.720	Agree
Overall Mean	**3.99**		**Agree**

Table 3 shows the current status of estimation by Estimate Type Used. The findings show that respondents generally experience minimal corrections when using Excel and AutoCAD yet still require multiple re-checks before final approval. This indicates that while current tools can produce acceptable outputs, they rely heavily on manual verification and individual diligence. The need for repetitive checking reflects the absence of built-in validation mechanisms and standardized computation templates, which limit efficiency and increase dependence on personal experience rather than system reliability.

Table 4
Current Status of Estimation in terms of Estimate Completion

Item Statement	M	SD	Interpretation
Considering the scope and number of items in building project estimations, I am able to meet the required deadlines with accuracy.	3.87	0.548	Agree
Overall Mean	**3.87**		**Agree**

Table 4 reveals the current status of estimation in terms of estimate completion. It indicates that, while the respondents agree they generally meet deadlines, the results imply that timeliness is achieved through compensatory effort rather than through process efficiency. Meeting deadlines under the current system often requires extended checking and manual coordination, which can strain workforce resources. This generally suggests that deadline compliance does not and will not necessarily equate to process optimization, and that further improvements are possible through standardized and automated estimation workflows.

Table 5
Current Status of Estimation in terms of Resource Availability

Item Statement	M	SD	Interpretation
I have enough skills and learning to perform estimation tasks.	4.22	0.56	Agree
I always have access to previous estimates and database resources for reference.	4.11	0,61	Agree
Overall Mean	**4.17**		**Agree**

Table 5 elicits the current status of estimation in terms of resource availability. It shows that engineers generally feel skilled and supported, with accessible resources; however, the absence of standardized databases and unified digital platforms limits the effective use of these resources. This highlights a system-level gap in which available knowledge and data are not fully leveraged due to fragmented, non-integrated estimation practices.

Impact of quantity estimation in a district building construction project. Table 6 presents the impact of quantity estimation on project's scope.

Table 6
Impact of Quantity Estimation in Terms of Scope

Item Statement	M	SD	Interpretation
The accuracy of quantity estimates significantly affects the project's cost, time, and scope.	4.40	0.62	Very high impact
Overall Mean	**4.40**		**Very high impact**

The very high impact rating indicates that the majority of respondents believe that quantity estimation significantly influences the project scope, reinforcing its importance for planning accuracy. This finding underscores the importance of accurate and reliable estimation practices in managing and controlling a project's scope. It highlights the importance of investing time and effort in quantity estimation processes to ensure that project constraints such as cost, time, and scope, are managed.

Table 7
Impact of Quantity Estimation in Terms of Cost Accuracy

Item Statement	M	SD	Interpretation
If unit prices are standardized using Detailed Unit Price Analysis (DUPA), we can also standardize how we compute the materials quantity.	4.29	0.73	Very high impact
Overall Mean	**4.29**		**Very high impact**

Table 7 reveals the impact of quantity estimation on cost accuracy. It indicates that the majority of respondents believe that the quantity estimation, particularly the standardization of how we compute material quantities, has a significant impact on the overall cost of a project. This underscores that cost overruns are not solely price-related but are often rooted in inconsistent quantity take-offs. Without standardized computation methods, even standardized unit prices cannot fully ensure cost reliability and may lead to variation orders that affect scope and schedule.

Table 8 shows the impact of quantity estimation on time. Respondents express strong overall agreement on the time-related impacts and see significant value in adopting software tools. While respondents recognize the time-saving potential of estimation software, the continued reliance on manual processes suggests unrealized efficiency gains.

Table 8
Impact of Quantity Estimation in Terms of Time

Item Statement	M	SD	Interpretation
Saving time is saving money.	4.47	0.50	Very high impact
A poor estimate can result in project delays.	4.24	0.80	Very high impact
The use of Estimation Software such as PlanSwift, STACK, ProEst, and Sage Estimates is significantly time-saving.	4.09	0.79	High impact
It is worth taking extra time to learn and try something new to make my job easier.	4.29	0.69	Very high impact
Overall Mean	**4.27**		**Very high impact**

This indicates readiness for digital adoption, constrained primarily by system availability rather than user resistance.

Table 9
Impact of Quantity Estimation in Terms of Time

Item Statement	M	SD	Interpretation
The Planning and Construction Sections of DPWH can greatly benefit from this standardization.	4.42	0.54	Strongly Agree
Planning Section productivity can improve when estimation time is reduced.	4.49	0.63	Strongly Agree
Variation Orders due to quantity changes will be minimized, and delays during the project implementation phase can be avoided.	4.42	0.54	Strongly Agree
Overall Mean	**4.44**		**Strongly Agree**

Table 9 presents the Level of Agreement in Quantity Estimation for DPWH building projects in Laguna. The insights highlight the significance of quantity estimation in DPWH building projects in Laguna. Respondents believe that implementing standardized estimation practices can yield significant benefits for both the Planning and Construction Sections.

These findings suggest that standardization should not just be seen as a technical upgrade but as a necessary managerial intervention that recognizes the potential for increased productivity and coordination between the sections. These emphasize the importance of investing in quantity estimation processes, standardization, and training within the DPWH organization to enhance project outcomes and efficiency. The insights can guide decision-making and resource allocation by highlighting the potential benefits of prioritizing quantity estimation practices.

Table 10
Extent of Recommendation of the Planning Section for a Quantity Estimation Standardization Plan

Item Statement	M	SD	Interpretation
The management is willing to provide trainings for optimized process software for quantity estimation adaptation. Outsource a trainer for a specific estimation software	4.31	0.85	Very High Recommendation
Testing of outputs and studying the recommended estimation software for a certain period of time is necessary	4.38	0.68	Very High Recommendation
Results from the current technique and software-manipulated estimates shall be compared with respect to scope, cost, and time required	4.33	0.60	Very High Recommendation
The cost of Estimating Software is not a hindrance to this standardization. The management can definitely purchase a certain Software for quantity estimation	4.27	0.65	Very High Recommendation
In this age of innovation, are you in favor of using software to standardize quantity estimates for building projects?	4.38	0.65	Very High Recommendation
Overall Mean	**4.33**		**Very High Recommendation**

Table 10 reveals the extent of recommendations from the planning section for a quantity estimation standardization plan. It indicates a very high recommendation for the standardization plan, specifically recommending to provide training and outsourcing trainers for a specific software, conducting testing and studying recommended software, and comparing results to evaluate the effectiveness of different techniques and software. The Planning Section also expresses a positive stance on the cost of software estimation, stating that it should not hinder standardization efforts, and emphasizes the importance of embracing software applications in the modern age of innovation.

By investing in training, testing, and software acquisition, the Planning Section aims to enhance the estimation process and contribute to the overall success of building projects. The management needs to consider the Planning Section's recommendations and allocate the necessary resources that support the standardization plan. This would involve providing the required training, facilitating collaboration among stakeholders, and ensuring a smooth transition to optimized process software for estimation. Embracing technology and implementing standardized practices can improve accuracy, efficiency, and transparency in quantity estimation.

Overall, the very high recommendation level demonstrates that the Planning Section sees quantity estimation standardization as a strategic intervention that can improve accuracy, reduce repetitive checking, and minimize variation orders during the project implementation phase. This reinforces the view that standardized digital estimation is not merely a technical enhancement but a management tool that supports overall development of building project delivery.

Relationship between level of agreement and quantity estimation when grouped according to profile. Table 11 echoes the results of the Spearman's Rho correlation analysis, which examined whether respondents' profiles are associated with their level of agreement regarding the impact of quantity estimation on scope, cost, and time.

Table 11
Significant Relationship between the Respondents' Profile and the Extent of Impact of Estimation

Study Variables	Spearman's Rho (ρ)	Extent of Impact	Scope	Cost	Time
DPWH Engineering District	Correlation Coefficient	0.098	0.099	0.033	-0.100
	Sig. (2-tailed)	0.521	0.519	0.832	0.515
	N	45	45	45	45
Age	Correlation Coefficient	0.181	0.271	0.014	-0.194
	Sig. (2-tailed)	0.235	0.071	0.928	0.202
	N	45	45	45	45
Sex	Correlation Coefficient	0.118	-0.046	-0.083	0.012
	Sig. (2-tailed)	0.439	0.763	0.586	0.936
	N	45	45	45	45
Educational Attainment	Correlation Coefficient	-0.031	0.238	0.034	0.039
	Sig. (2-tailed)	0.839	0.116	0.822	0.799
	N	45	45	45	45
Years of Service	Correlation Coefficient	0.150	.304*	0.048	-0.053
	Sig. (2-tailed)	0.326	0.042	0.755	0.729
	N	45	45	45	45

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

Across all variables tested, Engineering District, Age, Sex, Educational Attainment, and Years of Service, the correlation coefficients range from –0.194 to 0.304, which indicates weak to negligible associations. Most p-values exceed the 0.05 significance threshold, suggesting that the respondents' demographic characteristics do not meaningfully influence their views on the role of quantity estimation.
The only significant result appears in the correlation between Years of Service and Scope

(ρ = 0.304, p = 0.042). This suggests a positive and statistically significant relationship at the 0.05 level. Implies that employees with longer tenure in the Planning Section gain more years of experience, they become more well-versed and proficient in the project estimation tasks they have performed, experienced staff are more exposed to recurring issues such as incomplete take-offs, overlooked work items, or adjustments in plans during implementation, which reinforces their awareness of how critical accurate costing is at the planning stage.

The findings also reflect the study by Zakaria et al. (2020), which explained that quantity surveying work often depends heavily on a few experienced personnel, causing delays whenever these key individuals handle multiple tasks simultaneously. This situation is evident in DPWH, where senior planners take on most of the technical work, making the flow of estimation activities dependent on their availability. As a result, even simple clarifications or validations can slow down the entire process.

For all remaining profile variables, no significant relationship was found. This indicates that engineers across different districts, age groups, educational levels, and sexes share similar perceptions on the importance and influence of quantity estimation.

Taking all theoretical foundations together, the outcomes demonstrate that the constraint within DPWH Laguna is not rooted in its engineers but in the system, they use (requiring repetitive checking, no standardized computation templates, and the absence of optimized software). By addressing this constraint through a standardized, technology-enabled workflow, improvements in cost accuracy, time management, and scope definition can be realized. This shift does not simply reduce errors; it strengthens the entire planning process and supports more consistent, dependable output for building project estimates. From a TOC perspective, this enhances throughput. From a project management perspective, this reinforces the triangle's balance. Moreover, through Rogers' innovation model, DPWH Laguna is positioned to adopt and sustain improved processes for long-term organizational benefit gradually.

Proposed Quantity Estimation Standardization Plan for use in district building construction project. The implementation of the Quantity Estimation Standardization Plan should follow a phased approach to ensure effective adoption and sustainability. The initial implementation should begin with a pilot phase in selected engineering districts to evaluate practicality, identify operational issues, and allow a limited trial of the standardized process.

This should be followed by a structured training and capacity-building phase to equip planning personnel with the necessary technical competence and understanding of the standardized procedures. Upon successful pilot validation and training completion, the plan should proceed to full rollout through formal integration into organizational workflows and policy guidelines, accompanied by continuous monitoring and periodic evaluation to support long-term standardization and digitalization plan.

Table 12

Proposed Quantity Estimation Standardization Plan

Rogers' Stage	Objective	Action Steps	Responsible Unit	Expected Output
1. Knowledge	Build awareness and understanding of standardized estimation practices	- Conduct orientation on the importance of standardized quantity estimation. - Present findings of the study to all Planning Sections. - Share introductory materials on estimation software options	Planning Section Chief, IT Unit	Increased awareness of the new process
2. Persuasion		- Demonstrate benefits through sample walkthroughs. - Facilitate experience-sharing sessions among planners. - Highlight time savings and reduced errors from software adoption	Planning section	Acceptance and interest in adopting the new system
3. Decision	Enable offices to decide on adopting standardized tools and methods	- Pilot-test estimation software (e.g., PlanSwift, ProEst). - Compare manual/Excel results with software outputs. - Gather feedback from planners	Pilot Team, Planning Section	Software evaluation report
4. Implementation	Apply standardized processes and tools in actual building project estimates	- Roll out unified templates and standardized workflows. - Begin formal use of selected estimation software. - Establish peer-review protocols and cross-district consistency checks. - Launch the shared digital database for estimates and references	Planning Section	Standardized estimation system in place
5. Confirmation	Ensure sustainability and continuous improvement	- Conduct quarterly review meetings. - Adjust templates and workflows based on feedback. - Update the estimation database regularly. - Monitor accuracy, time improvements, and reduction of corrections	Planning Section Chief	Updated, sustained system

As shown in Table 12, effective implementation of the standardization plan requires a clear

description of organizational roles:

1. ***Planning Engineers.*** Responsible for applying standardized estimation procedures, providing feedback during pilot testing, and ensuring accuracy and consistency in quantity take-offs.

2. ***Planning Section Chief.*** Supervise and key decision maker at the section level, coordinating training and monitoring activities.

3. ***Information Technology Unit.*** responsible for the installation of computer software and the maintenance of equipment.

4. ***District Engineers.*** Serve as change facilitators by overseeing implementation at the district level, ensuring compliance, and coordinating training and monitoring activities.

Integrating Rogers' model ensures that the transition to standardized quantity estimation is not abrupt but guided, practical, and supported by evidence from the research findings. This structured approach also increases the likelihood of successful adoption within government offices where change often requires careful planning and gradual acceptance.

It is also worth mentioning that, to strengthen knowledge and standardization practice, planning personnel can attend PICQ's organized training sessions and seminars and acquire certification to enhance the credibility of quantity surveyors in the planning section of DPWH.

DISCUSSION

This study investigates the utilization of digital quantity estimation software among civil engineers in the DPWH Engineering Districts of Laguna, revealing a strong endorsement for a Quantity Estimation Standardization Plan to enhance cost control, schedule reliability, and overall productivity. While engineers recognize the value of digital tools in reducing manual rework and improving accuracy, the research identifies a gap between awareness and consistent implementation, with most personnel remaining in the knowledge and persuasion stages of Rogers' Diffusion of Innovations theory. Data analysis indicates that while years of service in the Planning Section moderately correlate with involvement, other demographic variables show negligible impact, suggesting that organizational factors—rather than personal resistance—are the primary drivers of adoption. From a construction management perspective, the study utilizes the Theory of Constraints (Goldratt, 1984) and the Project Management Triangle (Westland, 2025) to illustrate how manual bottlenecks currently compromise the balance of scope, time, and cost, further noting that alignment with ISO 9001:2015 principles could strengthen process control and risk management within these public institutions.

The researcher concludes that digital transformation within DPWH Laguna is both necessary and achievable, provided the organization addresses the structural and operational constraints that currently hinder progress. The findings confirm that higher levels of technical competency and interest are associated with a greater likelihood of software adoption, yet systemic issues such as limited access to licensed software and insufficient hardware act as critical bottlenecks that restrict overall performance. Because the current reliance on manual processes tends to increase planning duration and risk data inaccuracy, the transition to optimized digital tools is essential for maintaining project quality without necessarily increasing operational expenses. Ultimately, the successful progression from awareness to full integration requires deliberate management support and organizational reinforcement to ensure that civil engineers can deliver infrastructure projects that are consistently timely, cost-efficient, and high in quality.

To bridge the gap between awareness and adoption, it is recommended that the district

offices invest in updated hardware and licensed software while introducing digital tools through pilot initiatives to demonstrate practical benefits and reduce staff uncertainty. DPWH should develop standardized guidelines for digital procedures to ensure consistency across districts and formally adopt the Quantity Estimation Standardization Plan as a management intervention that includes necessary resources for training and software comparison. Furthermore, the agency should establish a monitoring system to track digital progress and create an internal environment that encourages knowledge-sharing and innovation among engineers. For future research, the scope should be expanded to include other regions or qualitative interviews to gain deeper insights into organizational factors, while also utilizing actual project records, such as estimate preparation duration and variation order data, to quantitatively assess the operational impact of software-assisted estimation.

Author contributions. (Not applicable)

Conflict of interest. The author declares no conflict of interest.

Funding source. This research received no external funding.

Artificial intelligence use. AI tools supported initial drafting of text; final revisions and accountability rest with the authors.

Ethics approval statement. This study was approved by the PUP-OUS Center for Research and Extension.

Data availability statement. All data supporting the findings of this study are included within the manuscript and its supplementary materials.

Acknowledgement. (Not available)

Publisher's disclaimer. The views expressed in this article are those of the authors and do not necessarily reflect the views of the publisher. The publisher disclaims any responsibility for errors or omissions.

REFERENCES

Alathamneh, S., Collins, W., & Azhar, S. (2024). *Automation in Construction, 165*, 105549, Science Direct. https://www.sciencedirect.com/science/article/abs/pii/S0926580524002851?

Breitmeyer, B. (2018). *The automation of construction estimation: Addressing human error and efficiency in project planning.* Construction Tech Press.

Business Research Insights. (2025). *Construction Cost Estimating Software Market size, Share, Growth, and Industry Analysis, and Regional Insights and Forecast to 2034,* https://www.businessresearchinsights.com/market-reports/construction-cost-estimating-software-market-121222

Dela Cruz, M. H., Aquino, G. P., Manzon, R. D. S., & Villar, M. J. M. (2022). Acceptability of Building Information Modeling in the Construction Industry in District IV, Nueva Ecija: Strengths, Weaknesses, and Barriers. *International Journal of Progressive Research in Science and Engineering.* https://journal.ijprse.com/index.php/ijprse/article/view/758

Department of Public Works and Highways (DPWH). (2015). *Department Order No. 163, s. 2015: Standard Forms of Program of Works (POW), Approved Budget for Contracts (ABC), and Detailed Unit Price Analysis (DUPA).* DPWH Official Gazette. https://www.dpwh.gov.ph

Department of Public Works and Highways (DPWH). (2017). *Department Order No. 137, s. 2017: Standard Format for Program of Works for Low-Rise*

Building Projects. DPWH Official Gazette https://www.dpwh.gov.ph

Department of Public Works and Highways (DPWH). (2019). Department Order No. 28, s. 2019: *Standard Format for Program of Works for High-Rise Building Projects.* DPWH Official Gazette https://www.dpwh.gov.ph

Department of Public Works and Highways (DPWH). *ISO 9001:2015 Certification* https://www.dpwh.gov.ph/dpwh/files/iso/2022%20ISO%20Certificates%20-%20Regional%20and%20District%20Engineering%20Offices.pdf

Goldratt, E. M., & Cox, J. (1984). *The goal: A process of ongoing improvement.* North River Press.

Gowthaman, S., et al. (2025). *Framework for managing deficiencies* and inefficiencies in quantity surveying-related software implementation. Construction Economics and Building, 25(2), 193. https://researchers.westernsydney.edu.au/en/publications/framework-for-managing-deficiencies-and-inefficiencies-in-quantit/

Hussain, A., Jamil M., Farooq M. U., Asim M., Rafique M.Z., & Pruncu C.I. (2021). Project Manager's Personality and Project Success: Moderating Role of External Environmental Factors, *MDPI Open Access Journals.* https://www.mdpi.com/2071-1050/13/16/9477

IntoAEC. (2025). How *estimate software helps construction firms with cost accuracy.* https://intoaec.ai/estimate-software-construction-cost-accuracy-aec/

Jiang, Z., & Xu, Y. (2024). *Application of BIM Technology in the Whole Process of Cost Management of a Construction Project.* Atlantis Press. https://www.atlantis-press.com/proceedings/cadpc-24/126000771

Landau, J. (2022). Modernizing the construction industry: Trends in procurement and digital planning. *Infrastructure Development Journal.*

Metkari A. A., Attar A. C. (2015). Application of Building Information Modeling Tool for Building Project. *International Journal of Science and Research (IJSR). 4*(5), 329. https://www.ijsr.net/archive/v4i5/SUB154028.pdf

Nomitech. (2023). *Excel vs. estimating software: Why construction estimators are switching.* Nomitech Cost Estimating. https://www.nomitech.com/cost-estimating/excel-vs-estimating-software-construction

Philippine Institute of Certified Quantity Surveyors (PICQS). (2025). https://picqs.org/about-picqs-academy/

Pishdad, P., & Onungwa, I. O. (2024). *ITcon, 29*, 528. https://www.itcon.org/papers/2024_24-ITcon-Pishdad.pdf

PMarketResearch. (2025). *AI takeoff software for the construction estimating market analysis.* https://pmarketresearch.com/it/ai-takeoff-software-for-construction-estimating-market/

Ramadan, B., & Nassereddine, H. (2023). Impact of technology use on workforce performance and information access in the construction industry. *Frontiers in Built Environment, 9.* https://www.frontiersin.org/journals/built-environment/articles/10.3389/fbuil.2023.1079203/full

Ramadhan, J. S., & Waty, M. (2025). Impact of change orders on cost overruns and delays in large-scale construction projects. *Engineering, Technology & Applied Science Research, 15*(1), 20291–20299. https://etasr.com/index.php/ETASR/article/view/9449

Rogers, E. M. (2003). *Diffusion of innovations (5th ed.).* Free Press.

Royal Institution of Chartered Surveyors (RICS). (2024). *What impact will AI have on quantity surveying?* https://www.rics.org/news-insights/what-impact-will-ai-have-on-quantity-surveying

Royal Institution of Chartered Surveyors (RICS). (2024). *Cost Prediction – Professional Standard (Global, 1st Edition).* https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/construction-standards/rics-cost-prediction-professional-statement-global-1st-edition

Rosel, T. (2025). *DPWH launches digital platform to streamline contractor transactions.* Manila Bulletin. https://mb.com.ph/2025/2/24/dpwh-launches-digital-platform-to-streamline-contractor-transactions

Siddiqui, F. H., Abdekhodaee, A., & Thaheem, M. J. (2017). *Analysis and design of a seven-story residential building using advanced civil engineering software.* Proceedings of the 2nd Pak-Turk International Conference on Emerging Technologies in the Field of Sciences and Engineering.

Stromberg, M. (2022). *Best construction technology examples for companies of all sizes.* Construction Coverage. https://idealcrm.app/construction-business/best-construction-technology-examples-for-companies-of-all-sizes/

Varma A. K. V., T M., Asadi S. (2016). *A Critical Comparison of Quantity Estimation for Gated Community Construction Project Using Traditional Method Vs PlanSwift Software: A Case Study.* https://www.academia.edu/31558328/A_CRITICAL_COMPARISON_OF_QUANTITY_ESTIMATION_FOR_GATED_COMMUNITY_CONSTRUCTION_PROJECT_USING_TRADITIONAL_METHOD_VS_PLAN_SWIFT_SOFTWARE_A_CASE_STUDY

Villaseñor, R. A. M. (2024). The public service digitalization in the Philippines: Towards a national program to capacitate digital frontliners. *Journal of Public Administration and Governance, 14*(2), 165. https://www.macrothink.org/journal/index.php/jpag/article/view/22106/pdf

World Bank. (2023). *The World Bank supports reforms for increasing digital technology adoption in the Philippines.* https://www.worldbank.org/en/news/press-release/2023/09/30/world-bank-supports-reforms-for-increasing-digital-technology-adoption-in-the-philippines

Westland, J. (2025). *The Triple Constraint in Project Management: Time, Scope & Cost.* ProjectManager. https://www.projectmanager.com/blog/triple-constraint-project-management-time-scope-cost

Zakaria, N., Ali, A. S., & Yi, T. Y. (2020). Application of the Theory of Constraints in a Quantity Surveying Firm. *Journal of Building Performance.* https://spaj.ukm.my/jsb/index.php/jbp/article/view/431/pdf