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Assessing Artificial Intelligence Adoption Readiness: A Framework for Digital Transition in The DPWH Nueva Ecija 1st District Engineering Office

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Abstract- ***Modern infrastructure project management increasingly relies on Artificial Intelligence (AI) and integrated digital tools to enhance efficiency, project transparency, and schedule compliance. However, a significant gap often exists between high-level central office digitization mandates and local field implementation capabilities. This study assessed the baseline AI adoption readiness of technical personnel and the institutional framework within the Department of Public Works and Highways (DPWH) Nueva Ecija 1st District Engineering Office in Talavera, Nueva Ecija, serving as the empirical foundation for a localized AI Implementation Plan. Utilizing a descriptive-quantitative research design, a complete enumeration sample of twenty-five (N = 25) technical personnel was surveyed, representing equal quotas (n = 5) across five core technical designations: Project Engineers, Resident Engineers, Project Inspectors, Materials Engineers, and Monitoring Personnel. Quantitative data was evaluated using weighted means, standard deviations, and a standardized five-point Likert scale continuum, while open-ended qualitative feedback was treated using thematic analysis. The empirical findings revealed that personnel possess a Moderately Aware level of general AI concepts ($\bar{x}$ = 3.38, SD = 1.10) and a Moderate Knowledge baseline regarding predictive data dashboards ($\bar{x}$ = 2.98, SD = 1.20). However, a sharp "proficiency gap" exists in specialized engineering software, with AI knowledge in Building Information Modeling (BIM) and Generative Design scoring lowest ($\bar{x}$ = 2.64). In terms of experience, while 100% of personnel utilize general AI tools for administrative drafting and reporting, only 12% to 16% engage with specialized civil engineering AI applications. Overall Organizational Readiness was evaluated as Partially Ready ($\bar{x}$ = 2.96, SD = 1.07), with solid data organization ($\bar{x}$ = 3.24) offset by severe structural bottlenecks in local software budget allocation likelihood ($\bar{x}$ = 2.64), internet infrastructure ($\bar{x}$ = 2.76), and official training provision ($\bar{x}$ = 2.76). The study concludes that frontline engineering staff do not reject AI technology but require clear central office Department Orders, internet infrastructure upgrades, centralized enterprise software licensing, and practical, civil engineering-specific prompt engineering workshops. These diagnostic gaps directly justify the strategic AI Implementation Plan formulated to guide the office through a smooth digital transition.***

I. INTRODUCTION

The Department of Public Works and Highways (DPWH) plays a crucial role in developing national infrastructure projects such as roads, bridges, flood control systems, and public facilities. The success of these projects depends heavily on efficient planning, constant field monitoring, and accurate documentation. In recent years, Artificial Intelligence (AI) and advanced digital tools have begun reshaping the construction industry globally. Recognizing this potential, government agencies like the DPWH are exploring how digital tools can optimize public works management. In a developing province like Nueva Ecija, where infrastructure directly drives economic growth and public service delivery, embracing these technical advancements can make a meaningful difference.

However, moving from traditional routines to an AI-driven system requires significant preparation. Many local offices cannot fully leverage new technology due to practical hurdles like limited technical knowledge, training deficits, and lack of specialized support systems. Because field staff may find it difficult to adjust to automated workflows overnight, an office must evaluate its baseline capabilities before forcing a digital transition. Therefore, this study aims to assess the readiness of both the personnel and the organization within the DPWH Nueva Ecija 1st District Engineering Office for the adoption of Artificial Intelligence in infrastructure project management. The findings will serve as the foundation for a practical, localized AI Implementation Plan.

A. RATIONALE

Good roads, bridges, and public buildings are the backbone of a strong economy. They connect communities, help businesses grow, and make sure vital public services reach the people who need them. In the Philippines, the Department of Public Works and Highways (DPWH) carries the heavy responsibility of building and maintaining this vital infrastructure. Globally, the construction industry is moving fast to adopt digital tracking tools and AI, which have been shown to cut project costs by 10% to 20% and significantly reduce construction delays. Following this global trend, the DPWH Central Office has introduced strict digital mandates—like electronic project reporting and mandatory geotagging—to eliminate human error, keep data accurate, and ensure every peso spent on public billings is transparent.

However, there is often a huge gap between a central office mandate and the reality on the ground. Studies on how technology is adopted in the public sector show that many local offices struggle to fully utilize these new tools. At the district level, field staff often face a massive training deficit, high software costs, and a lack of dedicated on-site IT support. On top of that, organizational research shows that workers naturally resist shifting away from familiar, paper-based routines to complicated automated systems, finding it difficult to adapt overnight.

While the global benefits of AI look great on paper, we don't yet fully understand what limits or supports technology adoption within specific provincial boundaries. This study fills that research gap by looking directly at the baseline preparedness of the DPWH Nueva Ecija 1st District Engineering Office in Talavera, Nueva Ecija. It is crucial to evaluate this specific office to see if the staff and the institution are genuinely equipped to handle these digital shifts. The insights gained here will be highly significant for DPWH leadership and project managers who need to understand the real capabilities and challenges their field teams face. By exploring these local realities, this study contributes fresh evidence to the broader conversation on digital readiness in public engineering, leading to a realistic Improvement Framework that solves training gaps, helps staff embrace digital tools, and guarantees that local infrastructure is managed transparently.

B. LITERATURE REVIEW

1. Global Trends in AI Adoption and Digital Engineering in Construction

International studies from the past ten years prove that utilizing Artificial Intelligence (AI) and integrated digital systems significantly enhances how project teams manage large-scale infrastructure projects (Regona et al., 2022). According to a global benchmark report published by McKinsey & Company (2021, as cited in Panahon & Florencondia, 2025), migrating from traditional workflows to advanced digital tools and AI can reduce overall construction costs by 10% to 20% while accelerating project timelines by up to 30%. Historically, construction tracking was completely manual, relying heavily on physical paperwork, blueprints, and fragmented spreadsheets. Over the last decade, however, the global infrastructure industry has fundamentally shifted toward centralized data environments. In technologically advanced nations such as Singapore and the United Kingdom, these digital engineering platforms are no longer treated as optional software; they are now strictly mandated by national policy on all public works to guarantee that public funds and resources are utilized with maximum efficiency (Panahon & Florencondia, 2025).

2. The Philippine Public Infrastructure Framework and DPWH Digitization Mandates

In the local context, the Philippine Department of Public Works and Highways (DPWH) has initiated systematic institutional reforms to digitalize its engineering frameworks. This includes the institutionalization of an official roadmap established in 2020 designed to integrate Building Information Modeling (BIM) principles into national public construction (Panahon & Florencondia, 2025). On a day-to-day operational level, the central agency has deployed several computerized tools to enhance workflow monitoring. These systems include real-time online project dashboards, centralized electronic document filing applications, and mandatory geotagging photography protocols (Philippine

Information Agency, 2025). The enforcement of these computerized validations aims to eliminate data manipulation, maintain transparency in project billing, and minimize human error across regional projects.

3. The Impact of Technology and Automation on Project Performance Metrics

Empirical assessments concerning automation in the local construction sector indicate that while advanced data modeling helps engineers execute precise operational decisions, the software yields measurable advantages on performance outcomes (Santos & Jocson, 2024). Field interviews and site surveys conducted by Panahon and Florencondia (2025) across various Philippine public infrastructure projects established that offices utilizing integrated digital platforms achieved a 10% to 20% optimization in their project budgets. This cost efficiency was primarily driven by the software's capability to detect design anomalies and material waste prior to structural implementation. Furthermore, Panahon and Florencondia (2025) found that these digitized projects minimized completion delays by 15% to 25%. The introduction of 4D computer modeling enabled engineering teams to visually simulate building schedules and proactively identify prospective logistical bottlenecks before they could impact the field timeline.

4. Operational Bottlenecks, Digital Hesitancy, and Training Gaps in Local Districts

Despite high-level agency mandates, empirical data gathered directly from local engineering offices reveals that the field-level adoption of these technical tools remains highly constrained and fragmented across regional jurisdictions (Santos & Jocson, 2024). Diagnostic studies by Panahon and Florencondia (2025) revealed a critical deficit in technical readiness among field staff: the vast majority of local construction personnel lack basic digital proficiency. Specifically, their research found that less than a quarter (25%) of active engineering professionals had ever received formalized, institutional training on advanced digital systems, forcing the remainder to rely on self-taught technical skills.

This proficiency gap extends to management, where less than a quarter of active field supervisors and middle managers express confidence in navigating digital tracking platforms. According to Panahon and Florencondia (2025), local implementation is systematically hindered by four distinct barriers:

- High financial overhead for software licensing and subscription costs.
- A severe lack of specialized, on-site technical IT support.
- Fragmented, uncoordinated data sharing between regional engineering offices.
- A deeply embedded, traditional administrative culture that actively resists moving away from familiar, paper-based verification habits.

C. SYNTHESIS

The collective body of reviewed literature establishes that Artificial Intelligence holds immense potential to drastically optimize the execution cost, timeline efficiency, and structural quality of public infrastructure (McKinsey & Company, 2021; Panahon & Florencondia, 2025). However, structural evidence indicates that technology cannot function in isolation; its operational efficacy depends heavily on targeted personnel training, individual user readiness, and robust institutional backing (Santos & Jocson, 2024). While international data mathematically confirms the capability of AI to revolutionize project management (Regona et al., 2022), local assessments highlight a severe discrepancy between the digitized strategic goals envisioned by the DPWH Central Office and the practical software competencies available within provincial engineering districts (Panahon & Florencondia, 2025). Consequently, for a local engineering district to derive actual value from AI adoption, the acquisition of advanced software applications must be deliberately paired with rigorous, step-by-step technical training designed to fully phase out obsolete, manual field validation routines.

D. CONCEPTUAL FRAMEWORK

To understand how individual capabilities and institutional settings shape technology adoption, this study utilizes the Independent Variable - Dependent Variable (IV-DV) model. This framework maps out how employee readiness and organizational capacity (the driving causes) directly determine the office's overall readiness to adopt Artificial Intelligence in project management (the effect).

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1. Independent Variables (IV): Readiness Factors

These are the baseline conditions and capabilities currently present within the district office. They are split into two distinct areas:

- Personnel Readiness: The human factor, measuring the staff's individual baseline. This includes their Awareness of AI principles and risks, their technical Knowledge of data analytics and tools, and their actual Experience (frequency and perceived effectiveness) using AI in their workflows.
- Organizational Readiness: The institutional factor, measuring the office's structural capacity. This covers the availability of Technological Infrastructure, Human Resource Capability (training and skills), Management Support (leadership backing), and Data and Information Systems Capability.

2. Dependent Variable (DV): Overall AI Adoption Readiness

This is the core outcome determined by the independent variables. It represents the collective state of preparedness of the DPWH Nueva Ecija 1st District Engineering Office to smoothly absorb, deploy, and sustain AI technologies within its infrastructure project management workflows.

3. The Research Output: AI Implementation Plan

The final bridge of the framework. By analyzing how the Independent Variables influence the Dependent Variable, the study identifies specific operational gaps. These insights directly inform the creation of a tailored Artificial Intelligence Implementation Plan designed to solve local training deficits, upgrade infrastructure, and guide the district office through a successful digital transition.

E. RESEARCH PROBLEM

This study aims to assess the artificial intelligence adoption readiness of the DPWH Nueva Ecija 1st District Engineering Office to serve as a baseline for developing a digital transition framework.

Specifically, it seeks to answer the following questions:

1. What is the level of awareness of DPWH personnel regarding Artificial Intelligence in terms of:
- AI concepts and principles;
- AI applications in infrastructure project management;
- AI benefits and opportunities; and
- AI risks and limitations?
2. What is the level of knowledge of DPWH personnel regarding Artificial Intelligence in terms of:
- AI tools and technologies;
- Data analytics and management;
- AI-assisted decision-making; and
- AI applications in construction and infrastructure projects?
3. What is the extent of experience of DPWH personnel in the utilization of Artificial Intelligence in terms of:
- Frequency of AI use;
- Types of AI tools utilized;
- Areas of AI application; and
- Perceived effectiveness of AI tools?
4. What is the level of organizational readiness of the DPWH Nueva Ecija 1st District Engineering Office for Artificial Intelligence adoption in terms of:
- Technological infrastructure;
- Human resource capability;
- Management support; and
- Data and information systems capability?
5. Based on the findings of the study, what Artificial Intelligence Implementation Plan may be developed for the DPWH Nueva Ecija 1st District Engineering Office?

F. SCOPE AND DELIMITATION

This study focuses on assessing the overall preparedness of the Department of Public Works and Highways (DPWH) to integrate Artificial Intelligence (AI) into its infrastructure project management workflows. The ultimate goal is to generate data to design a practical, customized AI Implementation Plan.

The scope is divided into two main evaluation areas:

- Personnel Readiness: Assessing the workforce's individual baseline, which includes their level of AI awareness (concepts, applications, benefits, and risks), their technical knowledge (tools, data

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analytics, and decision-making), and their hands-on experience (frequency of use and perceived effectiveness of digital tools).
- Organizational Readiness: Assessing the institutional framework of the office, specifically looking at its current technological infrastructure, human resource capability, management support, and data and information systems capability.

The primary data will be gathered directly from the core technical and field personnel who manage daily construction operations. The target respondents include:
- Project Engineers and Resident Engineers who handle site execution and daily operations.
- Project Inspectors and Monitoring Personnel responsible for field validation, progress tracking, and electronic logging.
- Materials Engineers who oversee quality control, material testing, and laboratory data analytics.

Delimitation
While the study examines AI readiness in public infrastructure, it is strictly bound by the following limitations:
- Geographic and Institutional Boundaries: The study is restricted exclusively to the DPWH Nueva Ecija 1st District Engineering Office located in Talavera, Nueva Ecija. It does not include, compare, or collect data from the 2nd District Engineering Office in Cabanatuan City, other district offices within the province, or any neighboring regional offices.
- Participant Boundaries: The respondents are limited strictly to the active project engineers, resident engineers, project inspectors, monitoring personnel, and materials engineers officially assigned to the 1st District. Administrative departments not involved in engineering or construction project tracking are excluded.
- Technical and Functional Boundaries: The study focuses strictly on evaluating readiness and capability to serve as a baseline roadmap. The study focuses strictly on diagnostic readiness and institutional capacity, explicitly excluding the empirical measurement of post-implementation project performance metrics like cost variances or schedule delays.
- Temporal Boundary: Data collection is restricted to the current 2026 operational cycle, meaning the findings will reflect the office's immediate, present-day capabilities and localized administrative realities.

G. SIGNIFICANCE OF THE STUDY
The findings of this study will offer valuable insights into the practical realities of adopting digital technologies and Artificial Intelligence (AI) in public sector construction management. By identifying readiness gaps and presenting a structured implementation roadmap, this research will directly benefit the following stakeholders:
- DPWH Central Office and Regional Policy Makers. This study provides top-level administrators with a clear picture of how digital mandates (like mandatory geotagging and electronic logs) actually play out on a local level. The data can help them design more realistic rollout schedules, allocate specific budgets for provincial tech upgrades, and create better-targeted national training policies.
- District Engineers and Local Leadership. For the leadership at the DPWH Nueva Ecija 1st District Engineering Office, this research serves as a diagnostic tool. It pinpoints exactly where their organization stands in terms of infrastructure and management backing, allowing them to make data-driven decisions to support their teams and improve administrative efficiency.
- The Frontline Engineering and Technical Staff. The Project Engineers, Resident Engineers, Project Inspectors, Materials Engineers, and Monitoring Personnel will benefit directly from the resulting AI Implementation Plan. By highlighting their specific training deficits and day-to-day challenges, this study paves the way for better on-site IT support, practical software training, and a smoother transition away from burdensome paper-based routines.
- The Public and Local Communities of Nueva Ecija. When local engineering offices successfully adopt digital tracking tools, public funds are managed more transparently, reporting errors drop, and projects face fewer delays. Ultimately, this ensures that local roads, bridges, flood controls,

and school buildings are built on time, within budget, and to high structural standards.

- Future Researchers and Academics. This study contributes fresh, localized evidence to the growing body of literature on AI and digital transformation in public sector engineering. Future researchers can use the methods, baseline data, and the developed framework as a reference point for evaluating technological readiness and digital transition barriers in other public engineering sectors.

H. DEFINITION OF TERMS

For the purpose of clarity and consistency throughout this study, the following terms are defined conceptually and operationally:

- Artificial Intelligence (AI): Conceptually, this refers to computer systems or software capable of performing tasks that traditionally require human intelligence, such as data analysis, pattern recognition, and decision-making. Operationally, it refers to the digital tracking tools, electronic reporting systems, mandatory geotagging platforms, and predictive analytics software mandated or considered for use by the DPWH.
- AI Adoption Readiness: The state of preparedness, willingness, and capacity of an organization to successfully integrate and sustain new digital technologies into its daily operations. In this study, it is the combined measurement of the personnel's capability (awareness, knowledge, experience) and the organization's structural support.
- Level of Awareness: The degree of mindfulness and baseline understanding regarding a specific subject. Operationally, this measures how well the DPWH personnel understand basic AI concepts, practical project applications, operational opportunities, and potential security or technical risks.
- Level of Knowledge: The depth of technical understanding and theoretical information possessed by an individual. In this study, it refers to the personnel's self-reported understanding of specific AI tools, data analytics, information management, and AI-assisted decision-making workflows.
- Extent of Experience: The practical, hands-on exposure an individual has had with a specific process or tool. Operationally, this tracks how frequently the engineering staff uses digital/AI tools, the specific types of software they use, and how effective they perceive those tools to be in the field.
- Organizational Readiness: The institutional capacity of an organization to absorb change and support new systems. In this study, it specifically measures the 1st District Engineering Office's technological infrastructure, human resource training capabilities, management support, and data systems.
- Project Engineers and Resident Engineers: Technical professionals responsible for managing, executing, and overseeing construction operations on-site. In this study, they represent the key respondents who ensure field operations align with digital project directives.
- Project Inspectors and Monitoring Personnel: Field staff tasked with validating project progress, checking compliance, and logging site updates. Operationally, they are the personnel directly responsible for utilizing electronic reporting and mandatory geotagging tools.
- Materials Engineers: Specialized engineers responsible for testing, quality control, and data management regarding construction materials. In this study, they serve as respondents whose workflows rely heavily on data accuracy and quality analytics.
- AI Implementation Plan: A strategic roadmap detailing the structured steps an organization must take to adopt new technologies. Operationally, this is the final output of the study—a tailored framework designed to bridge training gaps and guide the DPWH Nueva Ecija 1st District Engineering Office through its digital transition.

II. RESEARCH METHODOLOGY

This chapter presents the systematic methodology utilized to gather and analyze the empirical data for this study. It outlines the research design, the geographical and institutional locale, the target respondents, the sampling technique, the data gathering instrument, the administration protocols, validation methods, the step-by-step data collection procedure, statistical analysis techniques, and the strict

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ethical considerations observed throughout the process.

A. RESEARCH DESIGN

To systematically evaluate the baseline preparedness for technological integration, this study utilizes a descriptive-quantitative research design. A quantitative approach is selected because it allows the researcher to mathematically measure, categorize, and convert human and institutional traits—such as levels of awareness, technical knowledge, field experience, and organizational capacities—into objective numerical data.

A descriptive-quantitative design is utilized to systematically map and measure the baseline technical proficiencies, training deficits, and infrastructural capacities of the office during the 2026 operational cycle. It focuses on identifying existing technical proficiencies, training deficits, and infrastructural limitations. This descriptive data serves as the exact empirical foundation needed to develop a practical, customized AI Implementation Plan.

B. LOCALE OF THE STUDY

This study is conducted exclusively at the Department of Public Works and Highways (DPWH) Nueva Ecija 1st District Engineering Office, located in Talavera, Nueva Ecija.

This specific district office is responsible for implementing the core DPWH mandate at a localized level: the planning, design, construction, and maintenance of infrastructure facilities, especially national highways, flood control and water resource development systems, and other public works in accordance with national development objectives. Within its provincial jurisdiction, the 1st District Engineering Office oversees vital networks including farm-to-market roads, bypasses, bridges, and local flood control across the northern towns of the province.

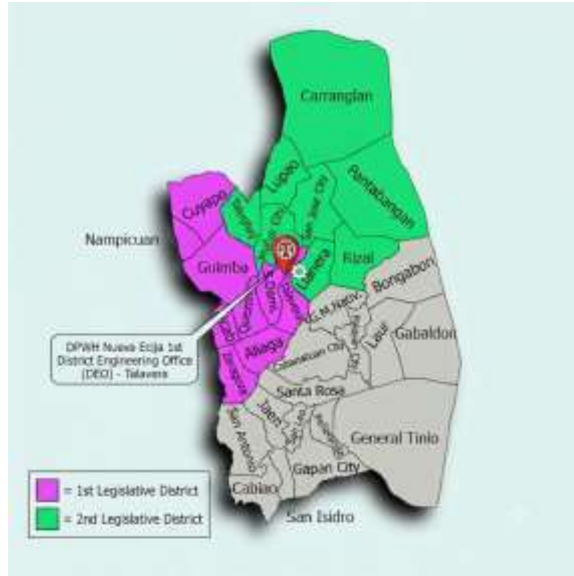

Figure 2.1. Map showing the research Locale of the Study within Nueva Ecija

C. RESPONDENTS OF THE STUDY

The respondents for this study consist entirely of the active technical field and tracking personnel currently stationed at the DPWH Nueva Ecija 1st District Engineering Office in Talavera. These specific individuals are targeted because they serve as the direct, hands-on users who must interact with, log field data into, and manage project monitoring platforms within their daily workplace routines.

To ensure the gathered data is deeply relevant to infrastructure project management workflows, administrative clerks, human resource staff, and support personnel not involved in construction tracking are excluded. To achieve a valid and balanced evaluation, a specific quota of exactly five (5) personnel from each key technical position has been designated, establishing a final sample size of twenty-five (25) respondents distributed as follows:

- Project Engineers (5 respondents): Technical professionals managing overall project execution, contract timelines, and physical milestone tracking.
- Project Inspectors (5 respondents): Field personnel responsible for conducting continuous site inspections, measuring physical progress, and validating build quality.
- Materials Engineers (5 respondents): Specialized engineering staff in charge of laboratory material

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testing, quality control compliance, and structural data analytics.

- Resident Engineers (5 respondents): Engineering staff stationed directly on-site to handle daily structural adjustments and physical operations.
- Monitoring Personnel (5 respondents): Technical team members responsible for maintaining active digital dashboards, tracking timelines, and processing electronic logging inputs.

Table 2. 1. Distribution of Respondents per Cluster (Complete Enumeration)

Respondent Clusters (Key Technical Positions)	1st District Engineering Office (Talavera)	Percentage (%)
Project Engineers	5	20.0%
Project Inspectors	5	20.0%
Materials Engineers	5	20.0%
Resident Engineers	5	20.0%
Monitoring Personnel	5	20.0%
GRAND TOTAL	25	100.0%

D. SAMPLING TECHNIQUE

To select the participants for this research, a non-probability Purposive Sampling design—specifically utilizing the Total Population Sampling (Complete Enumeration) technique—is employed. This approach is chosen because it allows the researcher to intentionally select respondents based on their explicit job descriptions, technical designations, and operational field experience, rather than selecting personnel at random.

Because this study evaluates highly specialized digital readiness, standard administrative staff or unrelated clerical workers do not possess the necessary hands-on field experience to provide valid assessment data. Utilizing total population sampling allows the researcher to establish explicit inclusion requirements so that the entire available universe of personnel holding these key operational roles within the district engineering office is completely surveyed.

Specifically, the study targets the complete enumeration of the following technical roles:

- Project Engineers handling overall site execution, contract timelines, and milestone scheduling.
- Project Inspectors performing continuous site inspections, measuring progress, and validating build quality.
- Materials Engineers overseeing laboratory material testing, quality control compliance, and structural data analytics.
- Resident Engineers stationed directly on-site to handle daily structural adjustments and field operations.
- Monitoring Personnel responsible for maintaining active digital dashboards, tracking timelines, and processing electronic logging inputs.

E. DATA GATHERING INSTRUMENT

The primary tool used to collect empirical data is a structured, researcher-constructed Survey Questionnaire, heavily informed by public sector technology adoption frameworks and perfectly aligned with the indicators established in the Statement of the Problem (SOP). The instrument is written in simple, everyday language and is divided into three main components:

Part I: Respondent Profile. A standard checklist format used to categorize the participants' professional background and specific technical designations without requiring long, manual written responses.

Part II: Personnel Readiness Assessment. This section contains structured scale items measuring the technical staff's capabilities across three areas: Level of Awareness (SOP 1: AI concepts, applications, benefits, and risks), Level of Knowledge (SOP 2: tools, data management, and decision-making systems), and Extent of Experience (SOP 3: frequency of use, types of tools utilized, and perceived software effectiveness).

Part III: Organizational Readiness Assessment. This section uses scale items to measure the staff's perception of institutional capacity across four

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indicators (SOP 4): technological infrastructure, human resource capability, management support, and data/information systems capability.

The questionnaire utilizes a customized scaling framework to capture field responses accurately. Part I uses a standard checklist. Part II, Part III, and Part IV utilize a 5-point Likert Scale (e.g., 5 – Strongly Agree / Always, 4 – Agree / Often, 3 – Neutral / Sometimes, 2 – Disagree / Rarely, 1 – Strongly Disagree / Never), allowing busy field personnel to easily select the option that best reflects their practical workplace experiences and operational challenges.

1. ADMINISTRATION OF INSTRUMENTS

Before distributing the survey questionnaires, a formal letter of request will be submitted to the District Engineer of the DPWH Nueva Ecija 1st District Engineering Office in Talavera to secure official institutional approval. Once cleared, the data gathering process will be managed flexibly to respect the demanding schedules of the technical and field staff:

In-Person Distribution: For engineers, inspectors, and monitoring staff who are available at the district headquarters or during regular office briefings, printed questionnaires will be distributed and collected personally by the researcher.

Electronic Distribution: For field personnel who spend the majority of their time deployed at remote infrastructure project sites, a secure digital version of the survey will be distributed via online forms. This allows them to answer the questions at their convenience using their smartphones or computers.

The distribution and tracking parameters are specifically targeted to ensure complete responses are gathered from all twenty-five (25) target respondents across the five core position clusters: Project Engineers, Project Inspectors, Materials Engineers, Resident Engineers, and Monitoring Personnel.

2. VALIDITY AND RELIABILITY OF THE INSTRUMENT

To guarantee that the survey questionnaire gathers high-quality, accurate data, it undergoes a strict validation process prior to final deployment:

Validation: The initial draft of the questionnaire is submitted to a panel of research experts and senior civil engineers. They review the items to ensure they are grammatically correct, easy for the field staff to understand, and perfectly aligned with the research objectives. Any confusing or unnecessary items are revised based on their expert feedback.

Reliability Testing: After passing the content validation, the questionnaire is pilot-tested on a small group of technical engineering personnel from a let neighboring district office who are not part of the final sample. The answers from this pilot test are statistically analyzed using Cronbach's Alpha to ensure the survey questions are stable, dependable, and consistent before full-scale distribution.

F. DATA GATHERING PROCEDURE

Data collection follows a structured, step-by-step process to ensure all information is gathered properly, organized, and with total respect for the schedules of the engineering staff.

Securing Official Permission: The first step is securing institutional approval. A formal letter of request is submitted to the District Engineer of the DPWH Nueva Ecija 1st District Engineering Office in Talavera. This letter outlines the research objectives and requests official authorization to conduct the survey among the technical staff.

Identifying the Target Population: Once management grants permission, the researcher coordinates with the office section heads to identify the active personnel who meet the specific inclusion criteria, creating a definitive list of target respondents.

Distributing the Questionnaires: The surveys are administered using a flexible method. For engineers and inspectors working primarily out of the Talavera headquarters, printed questionnaires are distributed and collected in person. For field personnel actively deployed at distant construction sites, a secure digital link to the survey is sent via online forms, allowing them to complete it on their smartphones or computers at their own convenience.

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Retrieving and Tracking Responses: The researcher monitors submissions closely and sends polite reminders through official communication channels to ensure a high response rate. All participants are continually assured that their individual responses will be kept completely confidential.

Data Compilation: Once all completed forms are retrieved, the raw data is pooled, verified for completeness, and carefully encoded into a centralized spreadsheet for statistical processing.

G. DATA ANALYSIS TECHNIQUE

To provide clear, reliable, and mathematically sound answers to the Statement of the Problem, the gathered data is treated using basic descriptive statistics:

Frequency and Percentage Distribution: Utilized to summarize the demographic profile of the respondents and organize their technical designations.

Weighted Mean: Utilized to calculate the average scores for the Level of Awareness (SOP 1), Level of Knowledge (SOP 2), Extent of Experience (SOP 3), and Perceived Level of Organizational Readiness (SOP 4).

To translate these calculated averages into clear, human meanings, the weighted means are evaluated using a standardized Five-Point Likert Scale continuum, structured as follows:

Table 2.2. Five-Point Likert Scale continuum

Mean Range	Personnel Readiness Interpretation (SOP 1–3)	Organizational Readiness Interpretation (SOP 4)	Tool Effectiveness Rating (SOP 3)
4.20 – 5.00	Very Highly Aware / Advanced Knowledge / Extensive Experience	Highly Ready	Extremely Effective
3.40 – 4.19	Highly Aware / Capable Knowledge / Moderate Experience	Moderately Ready	Effective
2.60 – 3.39	Moderately Aware / Moderate Knowledge / Minimal Experience	Partially Ready	Moderately Effective
1.80 – 2.59	Slightly Aware / Limited Knowledge / Very Low Experience	Low Readiness	Slightly Effective
1.00 – 1.79	Not Aware / No Knowledge / No Experience	Not Ready	Ineffective

The specific operational gaps, training deficits, and structural weaknesses revealed by these mean scores serve as the exact diagnostic data used to design and justify the final AI Implementation Plan (SOP 5).

H. ETHICAL CONSIDERATIONS

To protect the professional and personal well-being of all participants, strict ethical rules are enforced throughout the research cycle:

Voluntary Participation: Taking part in this study is entirely optional. The goals of the project are explained clearly before distributing the survey. No personnel are forced or pressured into participating, and all respondents retain the absolute right to skip questions or withdraw from the study at any point without facing any workplace consequences.

Guaranteed Confidentiality and Anonymity: The privacy of the respondents is protected under strict security. To encourage honest feedback regarding software costs, training deficits, and administrative culture challenges, the survey does not collect names, contact details, or employee IDs. Individual answers are aggregated and evaluated as a collective group, ensuring complete anonymity.

Academic Use Only: The information gathered is used solely to fulfill academic research requirements. The raw spreadsheet data is stored securely on an encrypted private drive, will never be shared with outside entities, and will be permanently deleted once the thesis defense is fully completed and approved.

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Proper Authorization: No data collection begins without formal, written authorization from management. Securing official permission from the District Engineer ensures the study is fully recognized, permitted, and compliant with institutional guidelines, adhering strictly to the principles of the Philippine Data Privacy Act.

III. RESULTS AND DISCUSSION

This chapter presents the empirical findings, statistical analyses, and qualitative insights derived from the data collected at the Department of Public Works and Highways (DPWH) Nueva Ecija 1st District Engineering Office in Talavera, Nueva Ecija. The presentation is structured systematically to address the primary objectives formulated in the Statement of the Problem (SOP):

1. Level of Personnel Awareness Regarding Artificial Intelligence (SOP 1)
2. Level of Personnel Knowledge Regarding Artificial Intelligence (SOP 2)
3. Extent of Experience in Utilizing Artificial Intelligence (SOP 3)
4. Perceived Level of Organizational Readiness for AI Adoption (SOP 4)
5. Proposed Artificial Intelligence Implementation Plan (SOP 5)

Demographic and Professional Profile of Respondents
A total of 25 technical and engineering personnel (N=25) stationed at the DPWH Nueva Ecija 1st District Engineering Office served as the complete enumeration sample for this study. To ensure representative coverage across core project execution and monitoring operations, exact equal-quota sampling was conducted across five distinct technical position clusters.

Table 3.1. Demographic and Professional Profile of Respondents (N = 25)

Profile Indicator	Categorical Breakdown	Frequency (n)	Percentage (%)
Designation / Role in Project Management	Project Engineer	5	20.0%
	Resident Engineer	5	20.0%
	Project Inspector	5	20.0%
	Materials Engineer	5	20.0%
	Monitoring Personnel	5	20.0%
Years of Service in DPWH	Less than 2 years	2	8.0%
	2 to 5 years	7	28.0%
	6 to 10 years	9	36.0%
	More than 10 years	7	28.0%
Total		25	100.0%

Discussion of Demographic Profile
The profile distribution demonstrates a well-balanced cross-section of technical field professionals. Exactly 20.0% (n = 5) of respondents were drawn from each primary engineering designation, ensuring that site execution (Project and Resident Engineers), quality control (Materials Engineers), field verification (Project Inspectors), and digital data tracking (Monitoring Personnel) are equally represented.

Regarding length of service, 64.0% of the engineering staff (n = 16) have served in the DPWH for 6 years or longer, with 28.0% (n = 7) possessing over a decade of operational experience. This institutional longevity indicates that the respondent pool possesses deep familiarity with traditional DPWH administrative procedures, paper-based field validation routines, and existing central office reporting platforms. Simultaneously, 36.0% (n = 9) have between 2 to 5 years or less than 2 years of service, representing a younger team of engineers who may be more receptive to modern digital tools.

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1. LEVEL OF AWARENESS REGARDING ARTIFICIAL INTELLIGENCE (SOP 1)

The first research objective evaluated the personnel's baseline awareness regarding Artificial Intelligence across four key dimensions: AI Concepts and Principles, AI Applications in Infrastructure Project Management, AI Benefits and Opportunities, and AI Risks and Limitations.

Table 3.2 Level of Personnel Awareness Regarding Artificial Intelligence

Sub-Category / Indicator Items	Mean ($\bar{x}$)	Standard Deviation (SD)	Verbal Interpretation
A. AI Concepts and Principles			
1. Basic definitions and core concepts of Artificial Intelligence	3.64	1.15	Highly Aware
2. The difference between standard software automation and AI capability	3.52	1.05	Highly Aware
Category Sub-Mean	3.58	1.09	Highly Aware
B. AI Applications in Infrastructure PM			
3. How AI is used to optimize project scheduling and resource allocation	3.16	1.14	Moderately Aware
4. The role of AI in structural health monitoring and predictive maintenance	3.16	1.18	Moderately Aware
Category Sub-Mean	3.16	1.15	Moderately Aware
C. AI Benefits and Opportunities			
5. Potential of AI to improve accuracy in cost estimation and budgeting	3.36	1.11	Moderately Aware
6. Capability of AI to enhance workplace safety monitoring on construction sites	3.36	1.08	Moderately Aware
Category Sub-Mean	3.36	1.08	Moderately Aware
D. AI Risks and Limitations			
7. Potential biases, errors, or inaccuracies in AI-generated reports	3.36	0.99	Moderately Aware
8. Ethical considerations and data privacy risks associated with using AI systems	3.48	1.12	Moderately Aware
Category Sub-Mean	3.42	1.05	Moderately Aware
OVERALL AWARENESS COMPOSITE	3.38	1.10	Moderately Aware

Note: 5-Point Likert Scale Continuum: 4.20–5.00 = Very Highly Aware; 3.40–4.19 = Highly Aware; 2.60–3.39 = Moderately Aware; 1.80–2.59 = Slightly Aware; 1.00–1.79 = Not Aware.

1.1 Discussion of Awareness Level

The overall composite mean for AI Awareness is 3.38 (SD=1.10), corresponding to "Moderately Aware."

The highest awareness ratings were recorded under AI Concepts and Principles ($\bar{x}$ =3.58, Highly Aware), driven by high comprehension of basic definitions $\bar{x}$ =3.64) and distinguishing AI from traditional automation ($\bar{x}$ =3.52). Personnel also demonstrated strong awareness regarding ethical considerations and data privacy risks ($\bar{x}$ = 3.48, Highly Aware).

Conversely, awareness scores dropped when evaluating specialized civil engineering applications, specifically project scheduling optimization ($\bar{x}$ = 3.16) and structural health monitoring ($\bar{x}$ =3.16). These findings align with Panahon and Florencondia

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(2025), who noted that while public sector civil engineers possess strong general conceptual literacy regarding digital technology, their specific awareness of field-level AI applications remains generalized.

2. LEVEL OF KNOWLEDGE REGARDING ARTIFICIAL INTELLIGENCE (SOP 2)

The second research objective assessed the technical depth of knowledge possessed by DPWH personnel across four domains: AI Tools and Technologies, Data Analytics and Management, AI-Assisted Decision-Making, and AI Applications in Construction and Infrastructure.

Table 3.3. Level of Personnel Knowledge Regarding Artificial Intelligence

Sub-Category / Indicator Items	Mean ($\bar{x}$)	Standard Deviation (SD)	Verbal Interpretation
A. AI Tools and Technologies			
1. Functional features of AI-powered engineering software (e.g., BIM, Generative Design)	2.64	1.25	Moderate Knowledge
2. Modern smart survey tools or AI-driven drones used for site inspections	2.88	1.27	Moderate Knowledge
Category Sub-Mean	2.76	1.25	Moderate Knowledge
B. Data Analytics and Management			
3. Methods for collecting, cleaning, and preparing project data for AI processing	3.08	1.26	Moderate Knowledge
4. Interpreting predictive data dashboards and performance analytics graphs	3.24	1.27	Moderate Knowledge
Category Sub-Mean	3.16	1.25	Moderate Knowledge
C. AI-Assisted Decision-Making			
5. Using AI insights to manage project bottlenecks, delays, and change orders	3.08	1.08	Moderate Knowledge
6. Utilizing predictive models to perform risk assessment before project procurement	3.16	1.18	Moderate Knowledge
Category Sub-Mean	3.12	1.12	Moderate Knowledge
D. AI Applications in Construction & Infrastructure			
7. Utilizing machine learning to forecast material supply chain demands	2.84	1.18	Moderate Knowledge
8. Technical workflows involved in deploying smart sensors on public infrastructure	2.88	1.17	Moderate Knowledge
Category Sub-Mean	2.86	1.16	Moderate Knowledge
OVERALL KNOWLEDGE COMPOSITE	2.98	1.20	Moderate Knowledge

Note: 5-Point Likert Scale Continuum: 4.20–5.00 = Advanced Knowledge; 3.40–4.19 = Capable Knowledge; 2.60–3.39 = Moderate Knowledge; 1.80–2.59 = Limited Knowledge; 1.00–1.79 = No Knowledge.

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2.1 Discussion of Knowledge Level

The composite mean for AI Knowledge across all technical domains is 2.98 (SD=1.20), indicating "Moderate Knowledge."

Engineers expressed their highest technical confidence in interpreting predictive data dashboards ($\bar{x}$ =3.24) and pre-procurement risk assessment models ($\bar{x}$ = 3.16). This capability is reinforced by existing DPWH central office mandates that require personnel to interact regularly with online executive dashboards and computerized project logging platforms.

However, knowledge scores drop sharply when evaluating specialized software tools, recording the lowest mean for functional features of AI in Building Information Modeling (BIM) and Generative Design ($\bar{x}$ = 2.64). This empirical result validates the regional findings of Santos and Jocson (2024), who identified a persistent "proficiency barrier" in local public engineering units.

3. EXTENT OF EXPERIENCE IN UTILIZING ARTIFICIAL INTELLIGENCE (SOP 3)

The third objective evaluated the actual, hands-on exposure of engineering personnel to AI tools in their daily workplace workflows, including frequency of use, tool types, application areas, and perceived software effectiveness.

Table 3.4. Frequency of AI Tool Utilization (N = 25)

Frequency Category	Response Count (n)	Percentage (%)	Cumulative Percentage (%)
Rarely	10	40.0%	40.0%
Weekly	8	32.0%	72.0%
Daily	5	20.0%	92.0%
Monthly	2	8.0%	100.0%
Total	25	100.0%	100.0%

Table 3.5. Specific Types of AI Tools Utilized and Work Application Areas

Category / Specific Indicator Items	Frequency (n)	Percentage (%)
Types of AI Tools Utilized *(Multiple Answers Allowed)*		
Generative Text / Assistants (e.g., ChatGPT, MS Copilot for documentation/emails)	25	100.0%
AI-Integrated CAD/BIM or Generative Design Software	4	16.0%
Project Management Software with Predictive Scheduling Extensions	3	12.0%
AI-Driven Drone Mapping or Smart Surveying Applications	3	12.0%
Primary Areas of Work Application *(Multiple Answers Allowed)*		
Report Writing, Translation, and Administrative Documentation	24	96.0%
Quality Assurance, Materials Testing Data Evaluation, or Site Safety Monitoring	5	20.0%
Design Generation, Optimization, and Structural Analysis	3	12.0%
Cost Estimation, Quantity Surveying, and Budgeting	3	12.0%
Project Scheduling, Timeline Monitoring, and Delay Prediction	3	12.0%

3.1 Perceived Effectiveness of AI Tools

Among personnel utilizing AI tools, the perceived overall effectiveness reached $\bar{x}$ =3.84 (SD=0.85), corresponding to a verbal interpretation of "Effective" (3.40–4.19).

3.2 Discussion of Experience Level

The empirical data reveals a striking structural dichotomy between administrative AI usage and specialized civil engineering AI usage:

- Universal General AI Adoption: 100.0% (n=25) of personnel utilize general text assistants (e.g., ChatGPT, Microsoft Copilot), with 96.0% (n=24) applying them directly to report writing and administrative drafting.

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- Severe Deficit in Engineering-Specific AI: Only 16.0% (n=4) use AI-integrated CAD/BIM tools, and only 12.0% (n=3) use AI for project scheduling, quantity surveying, or drone mapping.
- Usage Frequency: 40.0% use AI tools "Rarely," 32.0% use them "Weekly," and 20.0% engage "Daily."

Frontline staff actively leverage conversational AI to streamline administrative paperwork. However, due to licensing constraints and a lack of specialized training, they have not yet transitioned to utilizing AI for core structural design, cost estimation, or site inspection workflows. Despite this limitation, the high effectiveness rating ($\bar{x}$ =3.84) confirms that personnel recognize the strong value proposition of AI technology once integrated into their routines.

4. LEVEL OF ORGANIZATIONAL READINESS FOR AI ADOPTION (SOP 4)

The fourth research objective assessed the institutional capacity of the DPWH Nueva Ecija 1st District Engineering Office across four structural dimensions: Technological Infrastructure, Human Resource Capability, Management Support, and Data/Information Systems Capability.

Table 3.6. Perceived Level of Organizational Readiness for AI Adoption

Sub-Category / Indicator Items	Mean ($\bar{x}$)	Standard Deviation (SD)	Verbal Interpretation
A. Technological Infrastructure			
1. Powerful office hardware (computers, servers) capable of running advanced AI tools	2.84	1.07	Partially Ready
2. Stable internet connectivity and cloud infrastructure to support real-time operations	2.76	1.13	Partially Ready
Category Sub-Mean	2.80	1.09	Partially Ready
B. Human Resource Capability			
3. Personnel possess the foundational computer literacy needed to adapt to new AI systems easily	3.12	1.05	Partially Ready
4. Provision of sufficient training and workshops by the office to upskill employees	2.76	1.30	Partially Ready
Category Sub-Mean	2.94	1.19	Partially Ready
C. Management Support			
5. Office leadership actively promoting innovation and digital transformation initiatives	3.08	0.95	Partially Ready
6. Likelihood of management to allocate budget and resources for acquiring AI tools	2.64	1.08	Partially Ready
Category Sub-Mean	2.86	1.03	Partially Ready
D. Data & Information Systems Capability			
7. Systematic organization and digitization of project data (schedules, costs, blueprints)	3.24	0.93	Partially Ready
8. Solid protocols to ensure data security and integrity when sharing information	3.24	0.97	Partially Ready
Category Sub-Mean	3.24	0.94	Partially Ready
OVERALL ORGANIZATIONAL READINESS COMPOSITE	2.96	1.07	Partially Ready

Note: 5-Point Likert Scale Continuum: 4.20–5.00 = Highly Ready; 3.40–4.19 = Moderately Ready; 2.60–3.39 = Partially Ready; 1.80–2.59 = Low Readiness; 1.00–1.79 = Not Ready.

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4.1 Discussion of Organizational Readiness

The composite mean for Organizational Readiness stands at 2.96 (SD=1.07), indicating that the DPWH Nueva Ecija 1st District Engineering Office is "Partially Ready" to adopt AI technologies.

Evaluating the composite score under the 5-point continuum underscores that while foundational capabilities exist, structural barriers prevent full technological integration.

4.2 Structural Strengths

Data and Information Systems Capability recorded the highest sub-mean ($\bar{x}$ =3.24), supported by organized project digitization ($\bar{x}$ =3.24) and central data security protocols ($\bar{x}$ =3.24). Foundational computer literacy ($\bar{x}$ =3.12) and leadership encouragement of innovation ($\bar{x}$ =3.08) also demonstrated solid baseline support.

4.3 Operational Vulnerabilities and Bottlenecks

The assessment highlights three critical organizational bottlenecks:

- Financial and Budgetary Allocation ($\bar{x}$ =2.64): Personnel express strong skepticism regarding the district's ability to allocate independent capital budgets for software licenses and hardware.
- Internet Infrastructure and Hardware Limitations ($\bar{x}$ =2.76 & $\bar{x}$ =2.84): Field offices suffer from inconsistent internet connectivity, restricting real-time cloud analytics and drone monitoring integrations.
- Institutional Upskilling Provision ($\bar{x}$ =2.76): There is a severe deficit in formal, district-sponsored AI training workshops.

These findings directly echo Panahon and Florencondia (2025), who reported that provincial engineering offices in the Philippines are routinely bottlenecked by high software costs, inadequate hardware configurations, and uncoordinated local budget allocations.

5. PROPOSED ARTIFICIAL INTELLIGENCE IMPLEMENTATION PLAN (SOP 5)

To address the diagnostic gaps identified across personnel readiness, organizational infrastructure, and qualitative field feedback, a localized AI Implementation Plan was formulated. This framework provides a practical roadmap for guiding the DPWH Nueva Ecija 1st District Engineering Office through a smooth digital transition.

Table 3.7. Proposed AI Implementation Plan for DPWH Nueva Ecija 1st DEO

Strategic Pillar	Focus Objective	Action Items / Key Activities	Target Output / Key Indicator	Responsible Parties
Pillar 1: Policy & Data Governance	Establish regulatory clarity and data privacy compliance.	Draft local office guidelines referencing central Department Orders on ethical AI usage, cybersecurity, and data protection.	Official Office Policy Directive on Safe AI Integration	District Engineer, Administrative/Legal Unit
Pillar 2: Infrastructure Upgrade	Eliminate connectivity and hardware bottlenecks.	Allocate operational funds to upgrade office network stability and equip key technical staff with AI-capable workstations.	Dedicated high-speed broadband and deployment of upgraded hardware	District Management, IT Support Team
Pillar 3: Specialized Upskilling	Bridge the engineering software proficiency gap.	Conduct hands-on, task-based workshops on civil prompt engineering, AI-assisted scheduling, and BIM integrations.	Staff training completion certificates and localized prompt cheat sheets	Human Resource Unit, Technical Experts

Pillar 4: Mentorship & Culture	Overcome generational resistance among senior staff.	Implement a "Reverse Mentorship Program" pairing tech-savvy junior engineers with senior technical personnel for daily task assistance.	Structured peer learning sessions and reduced reporting turnaround	Lead Project Engineers, Junior Technical Personnel

5.1 Discussion

The proposed plan turns the research findings into real actions. Instead of just buying software, the plan focuses on four key areas—rules, equipment, training, and workplace culture—to make sure AI adoption is safe, practical, and effective.

- Setting Clear Rules (Pillar 1)

Before using AI, the office needs clear guidelines to protect sensitive government data and project plans. By creating a official policy, leadership ensures that staff use AI tools safely without breaking privacy laws or government regulations.

- Upgrading Equipment (Pillar 2)

Engineering software requires fast internet and strong computers. Pillar 2 fixes basic office hardware and connection issues first. This ensures that computers do not freeze or crash when running complex engineering tasks and scheduling software.

- Practical Training for Engineers (Pillar 3)

General computer training is not enough. Pillar 3 focuses on practical skills that civil engineers actually need, such as using AI to calculate project timelines and write technical reports. Providing quick-reference "cheat sheets" helps staff use AI in their everyday work.

- Encouraging Teamwork Across Ages (Pillar 4)

Older, senior staff may find new technology difficult to adopt, while younger staff are often more comfortable with digital tools. The "Reverse Mentorship Program" pairs junior engineers with senior engineers. Junior staff help with the software, while senior staff provide engineering experience. This speeds up work and builds good relationships in the office.

IV. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the summary of empirical findings, the conclusions derived from the statistical and qualitative analyses, and the actionable recommendations formulated to guide the Department of Public Works and Highways (DPWH) Nueva Ecija 1st District Engineering Office (DEO) toward effective Artificial Intelligence (AI) integration.

A. SUMMARY OF FINDINGS

The primary objective of this study was to evaluate the baseline awareness, technical knowledge, utilization experience, and perceived organizational readiness for AI adoption among technical and engineering personnel at the DPWH Nueva Ecija 1st District Engineering Office, ultimately serving as the empirical foundation for a localized AI Implementation Plan.

Using a total enumeration sample of 25 technical personnel (N = 25) distributed equally across five key job designations (Project Engineers, Resident Engineers, Project Inspectors, Materials Engineers, and Monitoring Personnel), the empirical findings are summarized below:

Demographic and Professional Profile of Respondents

- Designation Balance: The sample achieved an exact equal quota distribution (20.0%, n = 5 per group) across five primary engineering roles, ensuring equal representation across field execution (Project and Resident Engineers), quality control (Materials Engineers), field verification (Project Inspectors), and digital data tracking (Monitoring Personnel).
- Service Tenure: A majority (64.0%, n = 16) of respondents have served in the DPWH for 6 years or longer, with 28.0% (n = 7) possessing over a decade of operational experience. Conversely,

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36.0% (n = 9) have 5 years or less of service, reflecting a well-balanced mix of institutional experience and digital adaptability.

1. Level of Personnel Awareness Regarding Artificial Intelligence (SOP 1)

- The overall composite mean for AI Awareness was 3.38 SD = 1.10, interpreted as Moderately Aware.
- Respondents recorded their highest awareness in basic AI Concepts and Principles $\bar{x}$ = 3.58, Highly Aware), particularly regarding core definitions $\bar{X}$ = 3.64) and distinguishing AI from traditional software automation $\bar{X}$ = 3.52).
- Strong awareness was also demonstrated regarding Ethical Considerations and Data Privacy Risks $\bar{X}$ = 3.48, Highly Aware).
- Awareness was lowest in domain-specific civil engineering applications, specifically AI for Project Scheduling Optimization $\bar{X}$ = 3.16) and Structural Health Monitoring $\bar{X}$ = 3.16).

2. Level of Personnel Knowledge Regarding Artificial Intelligence (SOP 2)

- The overall composite mean for AI Knowledge across all technical domains was 2.98 SD = 1.20), interpreted as Moderate Knowledge.
- Technical confidence was highest in Data Analytics and Management $\bar{X}$ = 3.16), specifically in interpreting predictive data dashboards $\bar{X}$ = 3.24) and pre-procurement risk assessment models $\bar{X}$ = 3.16).
- Technical knowledge dropped sharply in specialized engineering software tools (AI Tools and Technologies sub-mean = 2.76), with the lowest individual indicator recorded for functional features of AI in Building Information Modeling (BIM) and Generative Design $\bar{X}$ = 2.64).

3. Extent of Experience in Utilizing Artificial Intelligence (SOP 3)

- Usage Frequency: 40.0% (n = 10) of respondents use AI tools "Rarely," 32.0% (n = 8) use them "Weekly," and 20.0% (n = 5) use them "Daily."
- Software Adoption Dichotomy: 100.0% (n = 25) of personnel reported using general text assistants (e.g., ChatGPT, MS Copilot), with 96.0% (n = 24) applying them directly to report writing and administrative drafting.
- Conversely, adoption was severely lacking in specialized civil engineering tools: AI-Integrated CAD/BIM (16.0%, n = 4), Predictive Project Scheduling (12.0%, n = 3), AI Drone Mapping (12.0%, n = 3), and Quantity Surveying/Cost Estimation (12.0%, n = 3).
- Perceived Effectiveness: Among active users, the overall perceived effectiveness of AI tools reached $\bar{x}$ = 3.84 SD = 0.85), interpreted as Effective.

4. Perceived Level of Organizational Readiness for AI Adoption (SOP 4)

- The overall composite mean for Organizational Readiness stood at 2.96 SD = 1.07), falling within the Partially Ready category.
- Key Organizational Strengths: The highest sub-mean was recorded under Data & Information Systems Capability $\bar{X}$ = 3.24), supported by organized project data digitization $\bar{X}$ = 3.24) and central data security protocols $\bar{X}$ = 3.24). Foundational staff computer literacy $\bar{X}$ = 3.12) also provided a solid baseline.
- Key Organizational Bottlenecks: Readiness was limited by low budget allocation for AI software licenses $\bar{X}$ = 2.64), unstable internet connectivity $\bar{X}$ = 2.76), lack of AI-capable hardware workstations $\bar{X}$ = 2.84), and insufficient office-sponsored training programs $\bar{X}$ = 2.76).

5. Proposed Artificial Intelligence Implementation Plan (SOP 5)

To address the diagnostic gaps, a four-pillar framework was formulated:

- Pillar 1: Policy & Data Governance (Drafting local guidelines referencing central Department Orders for ethical AI usage and privacy).
- Pillar 2: Infrastructure Upgrade (Allocating capital for dedicated high-speed broadband and AI-capable workstations).
- Pillar 3: Specialized Upskilling (Conducting practical workshops on civil prompt engineering, scheduling, and BIM).
- Pillar 4: Mentorship & Culture (Establishing a "Reverse Mentorship Program" pairing tech-savvy junior engineers with senior technical personnel).

B. CONCLUSIONS

Based on the empirical findings of the study, several key conclusions are drawn regarding the AI adoption readiness of the district engineering office.

1. Broad Conceptual Awareness vs. Limited Field Application Knowledge: A broad conceptual understanding of Artificial Intelligence exists among technical personnel, but awareness regarding specific civil engineering field applications remains limited. While technical staff demonstrate strong general awareness of basic AI principles and data privacy risks, their understanding of how AI automates schedule simulations, structural health monitoring, and predictive site maintenance remains non-specialized.

2. Technical Proficiency Barrier in Advanced Software: A technical proficiency gap constrains the adoption of advanced civil engineering software. Although engineers possess moderate knowledge in interpreting executive analytics dashboards required by central office mandates, there is a sharp deficit in hands-on technical proficiency regarding generative design, Building Information Modeling (BIM)-AI integrations, and smart sensor workflows.

3. Dichotomy in Utilization (High Administrative vs. Deficient Engineering Usage): AI utilization is high in administrative tasks but severely deficient in core engineering operations. Personnel heavily leverage general conversational AI assistants to reduce administrative reporting burdens. However, adoption has not transitioned into core civil engineering functions—such as structural analysis, cost estimation, and automated drone progress tracking—due to software licensing constraints and a lack of specialized training.

4. Partial Organizational Readiness Bottlenecked by Resources: Organizational readiness is partially prepared overall but strictly bottlenecked by policy, budget, and infrastructure limitations. While data organization and baseline computer literacy are solid, the district office cannot independently sustain a full digital transition without dedicated capital budget allocations for software licenses, internet infrastructure upgrades, and formal DPWH Central Office policy mandates.

5. High Latent Receptivity and Demand for Practical Upskilling: Technical personnel exhibit a strong willingness to adopt AI technology when provided with practical support. The high perceived effectiveness rating $\bar{x}$ = 3.84) and qualitative feedback confirm that staff do not reject AI technology; rather, they require structured, step-by-step upskilling tailored directly to their daily civil engineering paperwork and field verification tasks.

C. RECOMMENDATIONS

In light of the empirical findings and conclusions derived from this study, strategic recommendations are proposed for key institutional stakeholders.

1. For the DPWH Central Office and Regional Policy Makers

- Issue Policy Frameworks and Department Orders: Draft and issue official policy directives and Department Orders that establish clear operational, legal, ethical, and cybersecurity guidelines governing the safe use of AI tools in public works reporting and project management.
- Institutionalize Centralized Enterprise Software Procurement: Establish agency-wide procurement for AI-integrated civil engineering software, CAD/BIM platforms, and predictive scheduling extensions to secure enterprise licensing, eliminating financial and procurement overhead for local district engineering offices.

2. For District Leadership (DPWH Nueva Ecija 1st DEO)

- Upgrade Local Network Infrastructure and Field Hardware: Allocate operational funds to stabilize office internet bandwidth and equip field engineering personnel with modern, GPU-capable workstations to run cloud-based AI analytics and resource-intensive civil software without system latency.
- Adopt and Execute the Proposed AI Implementation Plan: Formally issue an internal directive adopting the localized 4-Pillar AI Implementation Plan developed in this study to

systematically guide the district office through its digital transition across all technical divisions.

2. For Engineering Personnel and Staff Upskilling

- Organize Task-Based Civil Engineering Workshops: Transition away from generic IT lectures toward hands-on, task-based workshops that train engineers in civil prompt engineering, automated progress logging, quantity take-offs, and predictive project scheduling.
- Implement a Cross-Generational Peer Mentorship Program: Establish a "Reverse Mentorship Program" pairing tech-savvy junior technical staff with senior project engineers to facilitate peer-to-peer software knowledge transfer, accelerate report turnaround times, and lower technology anxiety among senior personnel.

3. For Future Researchers and Academics

- Expand Diagnostic Framework Scope Nationally: Replicate this study's evaluation framework across other District Engineering Offices (DEOs) within Region III and nationally to build broader benchmarking data regarding public sector civil engineering digital readiness.
- Conduct Longitudinal Impact Assessments: Perform longitudinal studies following AI tool adoption to quantitatively measure post-implementation impacts on core civil engineering performance metrics, such as cost variance reduction, schedule compliance, and overall project delay mitigation.

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