Geotagging for Transparent Infrastructure Delivery: An Information Systems Success Model Assessment of the Philippine Rural Development Project

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Abstract: This study evaluates the effectiveness of geotagging technology in enhancing the monitoring of rural infrastructure projects under the Philippine Rural Development Project (PRDP). With the increasing demand for transparency, accountability, and real-time oversight in public construction, geotagging has emerged as a digital tool that offers location-specific, time-stamped visual data to support infrastructure supervision. The study assesses six key dimensions: system quality, information quality, service quality, use, user satisfaction, and net benefits.

Using a quantitative-descriptive research design, data were collected from 30 purposively selected respondents, including contractors, Department of Agriculture technical staff, and cooperative-level stakeholders. Surveys and focus group discussions were used to gather insights on the perceived usefulness, challenges, and operational impact of geotagging. Results showed that geotagging significantly improved project oversight, reduced the need for on-site inspections, and enhanced communication between stakeholders. High satisfaction levels were observed in terms of usability and the accuracy of geotagged data. However, technical issues such as device incompatibility, weak GPS signals in remote areas, and the need for regular updates were identified as constraints to optimal use.

The study concludes that geotagging is a reliable and scalable tool for public infrastructure monitoring, contributing to improved efficiency and governance. Recommendations include institutionalizing geotagging in project workflows, upgrading digital infrastructure, and expanding its application to all stages of project implementation. These findings offer valuable insights for agencies seeking to digitize infrastructure supervision across dispersed and rural environments.

***Keywords**: Geotagging Technology, Infrastructure Monitoring, Information Systems Success Model (ISSM), Project Oversight, Rural Development Projects.*

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I. INTRODUCTION

The Philippine Rural Development Project (PRDP), spearheaded by the Department of Agriculture (DA) and co-financed by the World Bank, is designed to modernize the agriculture and fisheries sectors by promoting value chain development and implementing climate-resilient strategies (World Bank, 2020). A significant component of the PRDP is the delivery of infrastructure projects in rural and remote communities. However, monitoring these projects presents substantial challenges, particularly in geographically dispersed areas where simultaneous construction activities occur. The limited mobility and field presence of technical and supervisory staff make it difficult to conduct timely inspections and enforce quality assurance. Traditional monitoring approaches, such as periodic site visits and manual documentation, are not only resource-intensive and delayed but also prone to miscommunication, errors, and governance risks, including project duplication and substandard output (Applied Clinical Trials, 2023).

In response to these limitations, the DA has integrated geotagging technology into the PRDP's implementation strategy. Geotagging involves embedding geographic coordinates such as latitude and longitude into photographs or videos taken at construction sites. These digital records provide real-time, visual, and location-specific evidence of project progress, allowing stakeholders to monitor

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implementation remotely (Irizarry et al., 2013). With the use of GPS-enabled mobile devices, contractors and field personnel can document daily accomplishments and share them with oversight teams, ensuring alignment with approved plans and enabling immediate decision-making (National Academies of Sciences, Engineering, and Medicine, 2024). This approach enhances transparency, minimizes delays, and fosters greater accountability throughout the infrastructure delivery process.

To comprehensively assess the effectiveness of geotagging in rural infrastructure monitoring, this study employs the Information Systems Success Model (ISSM) developed by DeLone and McLean (2003). Originally introduced in 1992, the model was substantially revised in 2003 to include measures of service quality and to adapt its applicability to modern digital environments. The ISSM offers a robust, multidimensional framework for evaluating the performance and impact of information systems. It focuses on six key dimensions: system quality, which examines the reliability and usability of geotagging tools in diverse field conditions; information quality, which pertains to the accuracy, timeliness, and relevance of uploaded data; service quality, which assesses the responsiveness and reliability of supporting systems such as application updates and technical support; use, which considers how consistently and effectively the technology is utilized in daily project monitoring; user satisfaction, which reflects the perceptions of contractors and monitoring teams regarding the system's usability and usefulness; and net benefits, which encompass broader outcomes such as enhanced decision-making, fraud prevention, and timely project completion.

This model is particularly relevant for public sector projects where technological tools are expected to deliver measurable improvements in operational efficiency, stakeholder communication, and governance transparency. As geotagging continues to gain traction among government agencies including the DPWH, DENR, and various LGUs a structured evaluation of its success through the ISSM framework can help institutionalize evidence-based practices and inform future digital innovations in public infrastructure monitoring (Mercurio, 2019; Philippine Statistics Authority [PSA], 2023).

II. METHODOLOGY

This study utilized a quantitative-descriptive research design to assess the effectiveness of geotagging technology in improving project monitoring, accountability, and construction efficiency under the Philippine Rural Development Project (PRDP). Aligned with the updated Information Systems Success Model (ISSM), the study evaluated system quality, information quality, use, and perceived net benefits, which are foundational constructs introduced by DeLone and McLean in their 2003 revision.

Data were collected through a structured survey administered to 30 purposively selected respondents, including contractor-side geotagging personnel, monitoring engineers, and technical staff from the Department of Agriculture. The survey instrument consisted of close-ended items rated on a 5-point Likert scale to measure perceptions of geotagging's effectiveness, challenges, and operational impact. Data were analyzed using descriptive statistics such as frequency distributions, means, and medians to summarize trends in user responses (Akinwande & Korabua, 2024).

To supplement the quantitative data, a focus group discussion (FGD) was conducted with five cooperative-level stakeholders to capture insights into their experiences using geotagging for project monitoring and documentation. While primarily qualitative, the FGD responses served to validate and contextualize survey findings. The geotagging process involved the daily collection of GPS-enabled, geotagged photographs documenting key construction phases using mobile devices. These images were securely stored on digital platforms or uploaded to mapping tools like Google Earth to support real-time, remote supervision (Rosen, 2024). This methodology enabled a practical and data-driven analysis of how geotagging supports construction oversight, communication, and transparency in rural development projects.

III. RESULTS AND DISCUSSION

This section presents the findings of the study on the use of geotagging technology in monitoring rural infrastructure projects under the Philippine Rural Development Project (PRDP). Data were gathered from 30 purposively selected respondents composed of contractors, monitoring engineers, and cooperative stakeholders. The analysis was guided by the Information Systems Success Model (ISSM) developed by DeLone and McLean (2003), which evaluates systems based on six key dimensions: system quality, information quality, service quality, use, user satisfaction, and net benefits.

A. System Quality: Real-Time Monitoring and Oversight

Geotagging technology was widely recognized for its ability to provide real-time, location-specific data that improved remote oversight and accountability. As shown in Table 1, 93% of respondents confirmed that the system enabled real-time monitoring, while 90% reported it reduced the need for frequent site visits. The overall mean rating for system reliability and usefulness was 4.56, with a median of 5, indicating strong user agreement.

These findings align with Rosen (2024), who noted that GPS-enabled geotagging provides reliable visual documentation that supports location-based construction oversight. Additionally, Samsara (n.d.) emphasized that systems integrating GPS allow teams to validate work progress without physical presence, improving time management and reducing manual inspections.

Table 1. System Quality: Real-Time Monitoring and Oversight

Indicator	Frequency	Percentage	Interpretation
Real-time monitoring capability	28	93%	Enabled real-time construction tracking and activity verification.
Accuracy of location-based data	27	90%	Geotagged photos effectively validated physical progress.
Usability of monitoring tools	26	87%	Tools were easy to operate for daily monitoring tasks.
Reduced site visits through remote verification	27	90%	Remote validation reduced cost and time of frequent field inspections.
Minimized miscommunication and faster approvals	25	83%	Enabled faster decision-making and clarification between teams.

B. Information Quality: Accuracy, Timeliness, and Verifiability

Geotagging was also found to improve the accuracy and timeliness of construction data. A total of 90% of respondents stated that the embedded GPS and time stamps in geotagged photos allowed accurate verification of work progress. This supports findings from Laudon & Laudon (2020) who noted that high-quality information systems provide users with complete, accurate, and timely information for decision-making.

Table 2. Information Quality Indicators

Indicator	Frequency	Percentage	Interpretation
Accuracy of geotagged documentation	27	90%	Provided visual and locational evidence of actual work done.
Timeliness of uploads	25	83%	Uploads were done daily or immediately after completion of tasks.
Use of before–during–after photo format	24	80%	Supported detailed progress tracking and improved work verification.

C. Service Quality: Technical Challenges in Implementation

Despite its advantages, geotagging tools presented challenges in remote areas including weak GPS signals, compatibility issues with older devices, and delays in application updates issues consistent with earlier findings from studies on geotagging accuracy and device limitations which is consistent with the findings of InfiniteJS (2024) and FasterCapital (2025) who identified connectivity and hardware compatibility as common barriers in mobile-based monitoring technologies.

Table 3. Service Quality Challenges

Challenge Encountered	Frequency	Percentage	Interpretation
Weak satellite signal in remote/cloudy areas	22	73%	GPS accuracy was affected, delaying or preventing tagging.
App compatibility and update limitations	20	66%	Some devices could not support or update the app properly.
Coordination for device maintenance and updates	19	63%	Regular app/device updates needed proper planning and training.

D. Use: Daily Integration and Operational Adoption

Daily utilization of geotagging was consistently reported, with all respondents (100%) confirming its use for documenting site activities. On average, 3–5 geotagged photos were uploaded per task to capture different stages of construction. These images were archived on cloud-based storage or transferred via USB for review and verification by the Department of Agriculture's technical team. This high rate of adoption reflects strong operational integration, aligning with the Use domain of the Information Systems Success Model (ISSM) and previous applications of digital monitoring systems in construction (Navas, 2018).

Table 4. Use of Geotagging Technology in Daily Monitoring

Indicator	Frequency	Percentage	Interpretation
Daily geotagging use	30	100%	All respondents confirmed consistent daily uploads during construction.
Average geotagged photos per task (3–5)	28	93%	Majority reported systematic documentation for each activity phase.
Use of secure storage (cloud/USB)	26	87%	Most respondents ensured proper archiving for accountability.

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The findings confirm that geotagging is fully embedded into the monitoring workflow, providing daily, real-time data that supports oversight and decision-making. This result demonstrates both the usability and practical necessity of geotagging in rural infrastructure projects.

E. User Satisfaction: Improved Communication and Accountability

Respondents rated their satisfaction with the system highly (mean = 4.47). Feedback highlighted that geotagging improved coordination, allowed faster feedback cycles, and fostered transparency a key feature emphasized in public digital governance tools (World Bank, 2021).

Table 5. User Satisfaction Themes

Aspect	Frequency	Percentage	Interpretation
Improved communication and response	27	90%	Clear photos enabled faster coordination between field and central teams.
Reduced miscommunication	25	83%	Discrepancies were quickly identified and resolved.
Trust in uploaded documentation	26	87%	Users trusted the system for transparency and monitoring integrity.

F. Net Benefits: Efficiency, Fraud Reduction, and Compliance

The perceived benefits of geotagging were substantial. Most respondents credited it with enhancing project timelines, ensuring better coordination, and discouraging fraud consistent with findings from National Academies of Sciences, Engineering, and Medicine (2024) noted that mobile-based monitoring tools such as tablet and smartphone inspection apps enable infrastructure teams to remotely validate work progress, improve transparency, reduce inefficiencies, and minimize the need for in-person inspections.

Table 6. Net Benefits Indicators

Benefit Realized	Frequency	Percentage	Interpretation
Improved oversight and decision-making	27	90%	Allowed monitoring teams to assess and approve remotely in real time.
Reduced implementation delays	25	83%	Timely validation accelerated construction phases.
Reduced fraud and project duplication	24	80%	Geotagging served as an anti-fraud mechanism through verifiable photo logs.
Enhanced compliance with construction standards	23	77%	Teams monitored quality output based on image documentation.

Table 7 Overall Summary Based on ISSM Dimensions

ISSM Dimension	Key Finding	Support Level
System Quality	High reliability, accuracy, and usability for daily use	Strong
Information Quality	Accurate, time-stamped data supports compliance	Strong
Service Quality	Some limitations due to GPS signal and app compatibility	Moderate
Use	Daily integration into construction workflows	Strong
User Satisfaction	Improved communication, reduced miscommunication	Strong
Net Benefits	Improved oversight, fraud prevention, and project efficiency	Strong

IV. INTERPRETATION

The results confirm that geotagging significantly improves infrastructure monitoring by enabling real-time, verifiable oversight with minimal physical presence. High adoption and satisfaction levels demonstrate strong alignment with the ISSM framework. However, sustained improvements require addressing technical limitations, especially in remote environments. These findings align with existing literature on mobile monitoring systems, providing valuable implications for scaling digital innovations in government infrastructure programs.

V. CONCLUSION

This study assessed the application of geotagging technology in monitoring rural infrastructure projects under the Philippine Rural Development Project (PRDP), using the Information Systems Success Model by DeLone and McLean (2003) as an evaluative framework. The findings indicate that geotagging significantly enhances construction oversight, operational efficiency, and stakeholder accountability. Across six ISSM dimensions system quality, information quality, service quality, use, user satisfaction, and net benefits the results consistently demonstrate the effectiveness of geotagging as a monitoring tool in geographically dispersed project sites.

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Geotagging tools provided real-time, location-specific documentation that enabled project managers to remotely verify physical accomplishments and minimize site visits a capability demonstrated in the successful scaling of mobile geotag technology in public infrastructure monitoring programs (Poulton, 2017). The accuracy and timeliness of geotagged data improved decision-making, allowed immediate corrective action, and supported transparent project documentation (Ryser et al., 2024). Geotagging helped reduce implementation delays, duplication, and fraudulent claims, affirming its practical role in ensuring compliance and governance (Philippine Government, 2015; World Bank Group, 2013).

However, technical challenges related to app compatibility, GPS signal loss in remote areas, and device maintenance impacted service delivery and field efficiency (Liu et al., 2019). Despite these constraints, the technology was consistently used and well-integrated into project workflows, with strong satisfaction among users and positive implications for broader institutional adoption.

RECOMMENDATIONS

In light of the study findings, it is strongly recommended that geotagging be institutionalized as a core component of construction monitoring in government infrastructure programs. Its ability to provide verifiable, real-time data enhances transparency, supports compliance monitoring, and streamlines oversight processes. As validated by similar studies (Amaral et al., 2014), geotagging significantly reduces reliance on manual inspections and mitigates miscommunication among project stakeholders.

To improve the system's functionality and reach, investments should be made in upgrading monitoring infrastructure. This includes equipping personnel with GPS-enabled mobile devices capable of supporting dual-satellite positioning systems such as GPS and GLONASS, which are more effective in remote or signal-poor areas (Oliveira et al., 2020). Equally important is the regular updating of geotagging applications to ensure compatibility with both Android and iOS platforms, as older devices were noted to experience technical limitations.

The development of a centralized dashboard that integrates geotagged photos with construction milestones and schedule monitoring systems is also recommended. This would allow technical staff to remotely track physical progress in real time, accelerate approval processes, and facilitate corrective actions when deviations from the plan are detected. Additionally, the dashboard should include annotation and comment features to improve communication and reduce the risk of data misinterpretation (Tserng et al., 2012).

To ensure consistent use and data quality, there should be continuous technical training and capacity-building for field users, especially in remote communities where infrastructure and digital literacy may be limited. Establishing a feedback mechanism and help desk support would also address service quality gaps, as noted in both the survey and focus group discussions.

Finally, it is recommended that the application of geotagging be expanded beyond construction monitoring to cover earlier and later stages of the project cycle, including planning, prioritization, and post-construction evaluation. As emphasized by the World Bank (2020), digital tools such as geotagging are valuable not only in documenting progress but also in fostering public accountability and transparency in government service delivery.

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