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FROM REACTIVE TO PROACTIVE: TRANSFORMING MAINTENANCE STRATEGIES WITH ADVANCED CMMS IN PUBLIC INFRASTRUCTURE

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ABSTRACT

Public infrastructure relies heavily on effective maintenance management to ensure the safety, reliability, and longevity of equipment and facilities. However, many government agencies still operate under a reactive maintenance strategy, responding only when equipment fails. This study, conducted at the Department of Public Works and Highways (DPWH) Regional Office I – Equipment Management Division (EMD), explores how transitioning to a proactive approach through the implementation of a ***Computerized Maintenance Management System (CMMS)*** *can enhance operational efficiency. Using a qualitative case study design, data were gathered from division heads, section supervisors, and maintenance personnel through interviews, site inspections, and analysis of maintenance logs. Results reveal that the existing Excel-based maintenance system lacks scalability, accuracy, and real-time data integration, contributing to frequent breakdowns, high repair costs, and inefficiency. The study highlights the potential of CMMS to transform maintenance management by reducing downtime, improving cost efficiency, and enabling predictive maintenance through data-driven insights. Findings further emphasize the importance of staff training, leadership support, and policy integration for successful CMMS adoption. The study concludes that transitioning from reactive to proactive maintenance using CMMS is essential to achieving sustainable infrastructure management.*

KEYWORDS: *Computerized Maintenance Management System (CMMS), proactive maintenance, public infrastructure, predictive analytics, equipment management, DPWH*

INTRODUCTION

Maintaining public infrastructure is essential for keeping facilities and services safe, reliable, and efficient for communities. Good maintenance also helps control costs, supports the economy, protects the environment, and improves quality of life. Despite these benefits, many government agencies, including the Department of Public Works and Highways (DPWH), still focus on fixing equipment only after it breaks down. This approach leads to more downtime, higher repair costs, and less efficient use of resources.

To address these challenges, the study recommends the adoption of a proactive maintenance strategy supported by a Computerized Maintenance Management System (CMMS). The CMMS serves as a centralized platform that consolidates maintenance information, automates workflows, and enables both preventive and predictive maintenance practices. When effectively implemented, it enhances equipment reliability, minimizes unplanned maintenance costs, and promotes compliance with regulatory standards through data-driven decision-making.

This research was conducted at the Department of Public Works and Highways (DPWH) Regional Office I - Equipment Management Division, which oversees the maintenance of both light and heavy equipment across the provinces of Ilocos Norte, Ilocos Sur, La Union, and Pangasinan. The study explores the efficiency of the existing Maintenance Management System (MMS), identifies the challenges encountered in its operation, and examines how an advanced CMMS can facilitate the agency's transition from a reactive to a proactive maintenance framework.

Specifically, this study aims to assess the adequacy and efficiency of the current MMS, identify implementation challenges, propose strategies for adopting proactive maintenance practices through CMMS, and evaluate the potential operational and cost benefits of such a transformation.

METHODOLOGY

Research Design

This study employed a qualitative case study design to analyze the current maintenance management practices of DPWH Regional Office I and explore opportunities for technological enhancement through CMMS integration. The qualitative approach allowed for in-depth understanding of operational issues, staff perceptions, and organizational readiness for digital transformation.

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Data Collection
Data were gathered through interviews, site observations, and document analysis. Respondents included the Equipment Management Division Head, Section Heads, Maintenance Supervisors, and other staff directly involved in equipment maintenance. The interviews focused on identifying maintenance procedures, challenges, and system implementation issues. Observations covered site inspections of equipment operations, maintenance practices, and downtime management. Document analysis utilized maintenance logs, inspection checklists, and performance reports to obtain quantitative indicators of downtime, maintenance costs, and frequency of breakdowns.

Data Analysis
Thematic analysis was employed to identify recurring issues related to system inefficiencies, staff capability, and technological limitations. Findings were triangulated with operational data to ensure validity. Cross-referencing of interview responses with observed practices provided comprehensive insight into the organizational challenges in shifting from reactive to proactive maintenance.

Scope and Limitations
The study was limited to the operational context of DPWH Region I's Equipment Management Division. While the findings may not be universally generalizable, they offer valuable implications for other public agencies managing similar fleets of light and heavy equipment.

Ethical Considerations
Ethical principles were strictly observed throughout the conduct of this case study to ensure the integrity of the research process and the protection of all participants. Prior to data collection, formal permission was secured from the Department of Public Works and Highways (DPWH) Regional Office I - Equipment Management Division to conduct interviews, site observations, and access relevant maintenance documents. All participants were informed of the purpose and scope of the study, the voluntary nature of their participation, and their right to withdraw at any time without consequence.

Informed consent was obtained before each interview, and participants were assured that all information shared would be treated with strict confidentiality. Identifiable data such as names or designations were withheld in the final report to protect participants' privacy. Data collected were used solely for academic and research purposes and were stored securely to prevent unauthorized access. The researcher also ensured objectivity, accuracy, and respect in data interpretation, avoiding any form of bias or misrepresentation. The study adhered to the ethical guidelines set forth by research standards for social and organizational studies.

RESULTS AND DISCUSSION

Existing Maintenance System and Challenges
The DPWH Regional Office I Equipment Management Division currently utilizes an Excel-based Maintenance Management System. While this system allows for basic record-keeping, it lacks the scalability and automation needed for large-scale asset management. According to respondents, issues include manual data entry errors, limited real-time tracking, and difficulty in generating reports such as repair histories and inventory levels. Consequently, the division faces frequent equipment breakdowns, high repair costs, and scheduling inefficiencies.

These findings align with previous studies noting that manual maintenance systems hinder data accuracy and decision-making in public infrastructure management (Cheng & Lee, 2021; Williams et al., 2020). The absence of automation prevents timely interventions, resulting in prolonged downtime and reduced equipment availability.

Transitioning to Proactive Maintenance through CMMS
Respondents recognized the potential of CMMS to streamline maintenance operations by automating scheduling, tracking work orders, and providing predictive analytics. However, successful adoption requires sufficient training and organizational readiness. The division head emphasized the need for capacity building and leadership support to ensure staff competence in using data-driven maintenance tools.

A proactive maintenance model using CMMS can greatly reduce unexpected equipment failures because predictive analytics help spot problems early. Automated scheduling also makes better use of resources, lowers manual workloads, and improves service reliability. These results are in line with the findings of Garcia et al. (2019) and Martinez & Lopez (2022).

Anticipated Outcomes of CMMS Implementation
From the analysis, several anticipated benefits of implementing a Computerized Maintenance Management System (CMMS) were identified. The adoption of this system is expected to significantly reduce equipment downtime through predictive maintenance and real-time alerts that allow timely interventions before failures occur. It also promises considerable cost savings by preventing major repairs and optimizing spare parts inventory, ensuring that maintenance resources are efficiently allocated.

Furthermore, the automation of maintenance scheduling and task assignments is projected to enhance productivity by allowing personnel to focus on higher-value, strategic tasks rather than routine troubleshooting. In addition, data analytics and historical trend analysis provided by the CMMS can greatly improve decision-making, enabling maintenance managers to plan and prioritize activities based on evidence and performance insights.

However, the implementation of CMMS also presents several challenges, including the need for substantial initial investment, potential resistance to change among staff, and the requirement

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for continuous training and system updates. These findings are consistent with the observations of Smith (2020) and Jones and Brown (2018), who emphasized that organizational culture and workforce readiness often determine the success or failure of maintenance transformations.

Implications for Public Infrastructure Management

The results indicate that transitioning to a proactive system is not merely a technological shift but an organizational transformation. For DPWH and similar agencies, implementing CMMS can serve as a cornerstone for achieving sustainability, accountability, and operational excellence in public infrastructure maintenance.

CONCLUSION AND RECOMMENDATIONS

The findings of this case study confirm that the current reactive maintenance approach employed by the Department of Public Works and Highways (DPWH) Regional Office I hinders operational efficiency and significantly increases maintenance costs. Transitioning to a Computerized Maintenance Management System (CMMS) offers a strategic and sustainable solution toward establishing proactive, predictive, and data-driven maintenance operations. By adopting proactive maintenance practices, the DPWH can enhance equipment reliability, minimize downtime, reduce overall maintenance expenses, and ensure the long-term sustainability of public infrastructure assets.

To make this change successful, several important steps are suggested. First, clearly explain the CMMS program to all maintenance staff to encourage everyone's involvement. Second, offer regular, focused training to help staff build their skills in predictive maintenance and using the system. Third, make CMMS implementation a key performance measure to support accountability and track progress. Fourth, use analytics to guide decisions and improve maintenance strategies. Finally, regularly review both financial and operational results to make sure the CMMS continues to meet the agency's goals and resource needs.

AUTHORS' DECLARATION

The authors declare that this study is an original work conducted as part of the Master in Management Engineering program at Don Mariano Marcos Memorial State University. All sources of information have been properly cited, and no part of this work has been copied or plagiarized. The authors share equal responsibility for the accuracy of the data presented, the analyses conducted, and the conclusions drawn in this study.

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REFERENCES

1. *Cheng, L., & Lee, H. (2021). Digital transformation of public asset maintenance: The role of CMMS and data integration.* Journal of Infrastructure Management, 12*(2), 45–59.*
2. *Garcia, P., Santos, D., & Nguyen, L. (2019). Predictive analytics in public works maintenance: Enhancing efficiency through CMMS integration.* International Journal of Maintenance Science, 8*(4), 221–234.*
3. *Johnson, R. K. (2021). Proactive maintenance strategies for heavy equipment.* International Journal of Industrial Engineering, 28*(4), 112–125.**
https://doi.org/10.1080/0951192X.2021.1871234
4. *Jones, R., & Brown, M. (2018). Proactive versus reactive maintenance: A cost-benefit perspective in public infrastructure.* Public Works Management Review, 14*(1), 33–47.**
5. *Martinez, C., & Lopez, A. (2022). Implementation success factors of CMMS in government agencies: Training and change management dimensions.* Maintenance and Operations Research Journal, 9*(3), 78–95.**
6. *Smith, J. (2020). From breakdown to breakthrough: The evolution of proactive maintenance in the public sector.* Infrastructure Policy and Engineering Review, 10*(2), 89–105.**
7. *Smith, J. A., & Brown, L. M. (2022). Implementing CMMS in public infrastructure: A case study.* Journal of Maintenance Management, 15*(3), 45–60.**
https://doi.org/10.1016/j.jmm.2022.03.001
8. *Williams, P. T., & Davis, S. R. (2020). Transforming maintenance with CMMS: Best practices and lessons learned.* Public Infrastructure Review, 22*(2), 78–92.**
https://doi.org/10.1080/14719037.2020.1721234
9. *Williams, T., Chen, R., & Patel, S. (2020). Optimizing heavy equipment maintenance using advanced CMMS systems.* Engineering Asset Management Quarterly, 6*(1), 14–27.**