ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 7| July 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

APPLYING THE PDCA CYCLE TO OPTIMIZE MAINTENANCE PROCESSES AT ILOCOS TRAINING AND REGIONAL MEDICAL CENTER (ITRMC)'S ENGINEERING UNIT

***Sylvanus C. Uzor, Grace A. Llobrera-Diamse,**
College of Graduate Studies - Don Mariano Marcos Memorial State University – Mid La Union Campus, Philippines

**Corresponding Author*

Article DOI: https://doi.org/10.36713/epra23024
DOI No: 10.36713/epra23024

ABSTRACT

Maintenance reliability in healthcare infrastructure ensures patient safety, operational efficiency, and compliance with quality standards. This study examines the application of the Plan-Do-Check-Act (PDCA) cycle as a strategic framework to address recurring maintenance challenges at the Ilocos Training and Regional Medical Center (ITRMC), focusing specifically on its Engineering Unit. Utilizing a qualitative case study design, data were collected through direct observations, document analysis, and semi-structured interviews with key personnel. The findings highlight a successful transition from a reactive maintenance approach to a proactive, data-driven system anchored in the PDCA methodology. Implementation of the cycle led to improved resource allocation, reduced service disruptions, and the institutionalization of preventive maintenance practices. Moreover, the initiative fostered a culture of continuous quality improvement within the organization. This research offers practical, evidence-based insights for other resource-constrained public healthcare institutions aiming to optimize infrastructure management and service reliability.

KEYWORDS: *Continuous Improvement, Healthcare Infrastructure, Hospital Engineering, Maintenance Management,PDCA Cycle, Preventive Maintenance,*

1. INTRODUCTION

The Ilocos Training and Regional Medical Center (ITRMC), located in San Fernando City in the Ilocos Region of the Philippines, has long stood as a cornerstone of public health in Northern Luzon. As a premier government hospital, it serves a dual purpose: as a regional referral center and a training institution for medical professionals. This dual mandate underscores ITRMC's pivotal role in the region's healthcare delivery and human resource development. Its commitment to service excellence was formally recognized in 2016 through its certification under ISO 9001:2015, which affirms its compliance with international standards in quality management systems.

A critical yet often overlooked component of ITRMC's operations is its Engineering and Maintenance Division, which ensures the continuous functionality and safety of the hospital's physical infrastructure. This includes plumbing systems, electrical networks, HVAC systems, and structural components—all essential for safe and uninterrupted healthcare delivery. Despite the hospital's reputable public image, persistent infrastructural issues threaten its capacity for high-quality and uninterrupted patient care.

Over the years, the Engineering Unit has contended with recurring challenges such as inconsistent water supply, frequent blockages in lavatories, malfunctioning doors, deteriorating physical fixtures, and the absence of essential safety infrastructure like functional handrails and proper signage. These issues reveal a predominantly reactive maintenance system, wherein problems are addressed only after they arise. While this approach may offer short-term resolutions, it is inherently unsustainable. It leads to greater inefficiencies, escalated repair costs, and heightened operational risks. From the perspective of patient care, even minor infrastructure failures can yield serious consequences: compromised sanitation disrupts infection control protocols, physical hazards increase the risk of falls, and unplanned equipment downtimes interrupt clinical workflows. These risks collectively diminish patient and staff confidence, ultimately eroding the hospital's ability to meet its public health mandate.

Globally, healthcare institutions have increasingly turned to structured process improvement models to bolster infrastructure resilience and reduce service disruptions. One such model is the Plan-Do-Check-Act (PDCA) cycle, conceptualized initially by W. Edwards Deming. The PDCA framework is recognized for its effectiveness in complex organizational environments and supports continuous, iterative improvement. Its strength lies in its flexibility: though initially applied in industrial and administrative contexts, it has demonstrated considerable success in healthcare, particularly in maintenance operations where interdependencies are high and the costs of failure are significant. The four-stage cycle—Plan, Do, Check, Act—encourages systematic problem-solving by enabling teams to identify root

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 7| July 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

causes, implement and monitor interventions, evaluate outcomes using performance metrics, and standardize effective practices. Moreover, it fosters a proactive, data-driven culture in contrast to traditional reactive approaches.

Recognizing these strengths, the present study seeks to investigate the application of the PDCA cycle in optimizing the maintenance management system of ITRMC's Engineering Unit. The study aims to identify inefficiencies, implement structured process improvements, and document measurable outcomes regarding maintenance performance, operational efficiency, and service reliability. Employing a case study methodology—combining direct observation, document analysis, and stakeholder interviews—this research demonstrates that even within a resource-constrained public healthcare setting, the systematic application of continuous improvement principles can result in meaningful organizational enhancements. In doing so, it contributes to the broader discourse on healthcare infrastructure management in developing contexts. It proposes a replicable model for similarly situated institutions seeking to reconcile cost-effectiveness with service excellence.

2. PURPOSE OF THE STUDY

This study examines the application of the Plan-Do-Check-Act (PDCA) cycle as a strategic framework for improving maintenance management practices within the Ilocos Training and Regional Medical Center (ITRMC) Engineering Unit. Amid growing operational demands and persistent infrastructure-related challenges, there is a pressing need for a structured, proactive approach to maintenance. The primary objective of this research is to explore how PDCA principles can be systematically integrated into existing workflows to identify the root causes of recurring infrastructure failures, implement and test targeted interventions, monitor their effectiveness, and institutionalize successful practices. By focusing on critical issues such as water supply inconsistencies, sanitation-related plumbing defects, and the deterioration of hospital facilities, the study seeks to demonstrate the PDCA cycle's capacity to facilitate continuous improvement, reduce service disruptions, and enhance the overall reliability of hospital operations. Ultimately, this research aspires to offer a replicable model for data-informed maintenance planning that can be adopted by other resource-constrained public healthcare institutions in the Philippines and similar settings globally.

3. METHODOLOGY

This study employed a single-case qualitative research design to investigate the application of the Plan-Do-Check-Act (PDCA) cycle in optimizing maintenance operations within the Engineering Unit of the Ilocos Training and Regional Medical Center (ITRMC). The case study approach was chosen for its ability to generate an in-depth, contextualized understanding of real-world challenges and interventions within a complex institutional environment. The ITRMC Engineering Unit was selected as the focal point of analysis due to its vital role in maintaining the hospital's physical infrastructure and supporting the uninterrupted delivery of healthcare services.

A triangulated data collection strategy was adopted to ensure the validity and richness of the findings. First, direct observations were conducted across various hospital departments to evaluate maintenance workflows, infrastructure conditions, and the responsiveness of engineering personnel to service requests. These observations provided valuable firsthand insights into the day-to-day realities of maintenance operations. Second, semi-structured interviews were held with key stakeholders, including engineers, maintenance technicians, foremen, and administrative aides. These interviews explored their experiences, challenges, and perceptions regarding the existing maintenance system and the implementation of the PDCA framework. Third, an extensive review of institutional documents encompassed job order logs, preventive maintenance checklists, ISO-aligned quality procedures, and performance reports. These records offered a comprehensive overview of the Engineering Unit's operational structure and historical maintenance trends.

Ethical considerations were rigorously observed throughout the research process. Formal authorization was secured from ITRMC's administrative leadership, and all participants were informed about the study's purpose, their voluntary participation, and the confidentiality of their responses. The PDCA cycle functioned as both a conceptual framework and a practical tool, guiding the analysis and structuring the implementation of maintenance improvements.

4. PRESENTATION OF CASE

The Ilocos Training and Regional Medical Center (ITRMC) is a tertiary-level government hospital that functions as a regional referral center for Northern Luzon. The engineering unit is a critical component of its operations and is responsible for maintaining the hospital's physical infrastructure. This includes plumbing systems, carpentry works, safety signage, and the fabrication of essential components such as handrails and structural reinforcements. The unit comprises a multidisciplinary team of engineers, plumbers, carpenters, painters, and administrative staff working collaboratively to ensure a safe, functional, and compliant hospital environment.

The responsibilities of the Engineering Unit extend beyond routine maintenance and emergency repairs. The team is also tasked with conducting regular inspections, implementing infrastructure rehabilitation projects, and ensuring compliance with ISO-aligned quality management standards. Despite its pivotal role, the unit has grappled with several operational challenges. These include outdated procedural workflows, insufficient manpower in specialized trades, and a fragmented task tracking system that relies heavily on manual job order logging and verbal coordination

.

Before implementing the Plan-Do-Check-Act (PDCA) cycle, maintenance operations at ITRMC were largely reactive—

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 7| July 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

interventions were carried out only after infrastructure failures occurred. This approach led to frequent service interruptions, higher operational costs, and reduced efficiency. The absence of a structured preventive maintenance program further compounded these issues, resulting in recurring problems such as water shortages, clogged drainage systems, malfunctioning fixtures, and deteriorating carpentry across various departments.

In response to these inefficiencies, the Engineering Unit initiated integrating the PDCA cycle into its maintenance management framework. This shift involved several key reforms: the establishment of a more systematic job order processing system; the introduction of visual work assignment tools, such as a publicly visible duty board; and the institutionalization of checklists and feedback mechanisms to standardize procedures and monitor outcomes. These efforts aimed to transition the unit from a reactive to a proactive maintenance culture, ultimately enhancing the hospital's physical operations' reliability, safety, and sustainability.

5. ANALYSIS AND FINDINGS

Implementing the Plan-Do-Check-Act (PDCA) cycle within the Engineering Unit of the Ilocos Training and Regional Medical Center (ITRMC) led to notable improvements across key maintenance domains. One of the most critical issues addressed was the frequent shortage of water supply, which had previously compromised hygiene protocols, disrupted surgical procedures, and impacted patient comfort. The engineering team thoroughly assessed the hospital's water storage capacity and pump system performance during the planning phase. This diagnostic process revealed inefficiencies in the distribution network and inconsistencies in the replenishment schedule. In response, scheduled water deliveries were introduced, and personnel were assigned to monitor tank levels and manage distribution. Weekly tank usage and delivery logs tracking enabled real-time adjustments and ensured continuous availability. As part of the "Act" phase, a long-term water distribution redesign was proposed, including recommendations for system upgrades and the strategic installation of additional storage tanks to improve resilience.

Another persistent concern involved the hospital's plumbing and sanitation systems, particularly in high-use areas where sinks and toilets were prone to frequent clogging. Utilizing the PDCA framework, the Engineering Unit reviewed historical maintenance records to detect blockage patterns and identify root causes. Targeted solutions were then implemented, such as procuring specialized tools and establishing a regular flushing schedule to prevent buildup. Effectiveness was measured through a decline in service call-ins and user complaints. As a result, routine drainage inspections were institutionalized as part of the hospital's preventive maintenance protocols, reducing the risk of service interruptions and improving overall sanitation.

Beyond technical enhancements, the PDCA cycle improved workflow organization and task accountability. A billboard-based work assignment display system was introduced to enhance transparency and efficiency in job distribution. Job order slips were standardized and publicly posted beneath the names of responsible personnel, enabling staff to track, assess, and complete assigned tasks more effectively. This visual tool minimized delays caused by unclear communication or role ambiguity, fostering a stronger sense of accountability. These findings highlight the PDCA cycle's capacity to transform a previously reactive and fragmented maintenance system into a proactive, structured, and data-informed one.

6. DISCUSSION

This study's results affirm the PDCA cycle's efficacy as both a corrective and preventive tool in healthcare facility maintenance management. Aligned with previous research, the iterative nature of the PDCA model enabled the Engineering Unit at ITRMC to identify inefficiencies systematically, execute targeted interventions, and refine practices based on real-time feedback. As Yokota et al. (2017) emphasized, the PDCA cycle improves planning accuracy and nurtures a culture of continuous improvement, particularly in complex environments where infrastructure reliability directly impacts service quality.

At ITRMC, the structured application of the PDCA cycle allowed the Engineering Unit to move beyond ad hoc solutions and address the underlying causes of persistent issues such as water shortages and plumbing failures. One of the model's core strengths lies in its simplicity and adaptability. The framework was readily understood and implemented by technical and administrative personnel, requiring minimal training but substantial operational gains. The introduction of the visual work assignment system, for example, empowered staff members to take ownership of their tasks and improved interdepartmental communication and coordination.

More significantly, the PDCA cycle catalyzed a cultural shift within the Engineering Unit—from reactive maintenance to strategic oversight. This transformation is particularly crucial in a hospital setting, where infrastructure failures can jeopardize patient safety, delay essential procedures, and erode public confidence in healthcare services. The Engineering Unit enhanced its effectiveness by embedding a continuous improvement cycle into everyday operations and contributed meaningfully to ITRMC's broader mission of delivering safe, efficient, and uninterrupted healthcare.

7. CONCLUSIONS

This study demonstrates that the structured application of the Plan-Do-Check-Act (PDCA) cycle can substantially improve maintenance operations within a public healthcare institution. At the Ilocos Training and Regional Medical Center (ITRMC), the Engineering Unit successfully shifted from a predominantly reactive maintenance model to a proactive, data-driven approach grounded in root cause analysis, preventive interventions, and continuous performance monitoring. Implementing the PDCA framework resulted in tangible improvements across several

ISSN (Online): 2455-3662
EPRA International Journal of Multidisciplinary Research (IJMR) - Peer Reviewed Journal
Volume: 11| Issue: 7| July 2025|| Journal DOI: 10.36713/epra2013 || SJIF Impact Factor 2025: 8.691 || ISI Value: 1.188

domains, including water supply management, plumbing system reliability, and task coordination. These enhancements minimized service disruptions, reduced operational costs, and supported the hospital's adherence to ISO-based quality management standards.

The ITRMC case illustrates that adopting a robust yet straightforward improvement methodology can yield significant and sustainable benefits even in resource-constrained environments. As applied in this context, the PDCA cycle proved to be a practical and replicable model for driving operational efficiency and fostering a culture of continuous improvement. Other healthcare institutions seeking to enhance infrastructure reliability and service quality may draw valuable insights from this initiative.

8. RECOMMENDATIONS

Based on the findings of this study, several recommendations are proposed to reinforce and expand the improvements achieved through implementing the PDCA cycle.

First, it is essential to institutionalize PDCA training by conducting regular workshops and refresher sessions for all engineering personnel. This will help maintain and enhance staff proficiency in applying the methodology while fostering a shared commitment to continuous improvement across the team.

Second, the hospital should consider digitizing its job order system. Transitioning from manual logging to a digital platform will enable real-time task tracking, facilitate data analytics, and improve performance monitoring. In addition, a digital system would enhance transparency, accountability, and resource management, leading to more efficient maintenance operations.

Third, preventive maintenance should include other critical hospital systems such as HVAC units, electrical networks, and biomedical equipment. By proactively addressing these areas, the hospital can better prevent service disruptions and uphold patient safety standards.

Fourth, establishing a formal feedback mechanism is strongly recommended. Creating structured communication channels between clinical departments and the Engineering Unit will allow for more responsive maintenance planning and ensure that infrastructure concerns from frontline service areas are prioritized and addressed appropriately.

Finally, to sustain momentum and assess long-term outcomes, ITRMC should conduct annual audits of PDCA implementation. These audits should evaluate key performance indicators such as cost-efficiency, infrastructure reliability, response times, and user satisfaction.

By adopting these recommendations, ITRMC can further embed continuous improvement into its organizational fabric and ensure the long-term sustainability of its maintenance reforms.

REFERENCES

1. *Al-Zubaidi, H. (1997). Assessing the demand for building maintenance in a major hospital complex. Property Management, 15(3), 173–183. https://doi.org/10.1108/02637479710178189*
2. *Ani, A. I. C., & Ali, R. B. (2019). Facility management demand theory. Journal of Facilities Management, 17(4), 344–359. https://doi.org/10.1108/jfm-09-2018-0057*
3. *Chew, M. Y. L. (2021). Design for maintainability of basements and wet areas. Buildings, 11(2), 75. https://doi.org/10.3390/buildings11020075*
4. *Dejaco, M. C., Gramigna, M., & Moretti, N. (2019). Plant maintenance in hospitals facilities. IOP Conference Series: Earth and Environmental Science, 296(1), 012030. https://doi.org/10.1088/1755- 1315/296/1/012030*
5. *Johnson, M., & Bosworth, R. (2021). Maintenance optimization through the PDCA cycle. Healthcare Engineering Journal, 44(2), 233–245.*
6. *Marais, K., & Saleh, J. H. (2019). Beyond root cause analysis: Towards effective socio-technical system safety. Safety Science, 117, 563–572.*
7. *Mobley, R. K. (2020). Maintenance Fundamentals (3rd ed.). Butterworth-Heinemann.*
8. *Pan, N., Luo, Y. Y., & Duan, Q. X. (2022). The influence of PDCA cycle management mode on healthcare worker productivity. BioMed Research International, 2022, Article 9352735. https://doi.org/10.1155/2022/9352735*
9. *Wireman, T. (2021). Developing Performance Indicators for Managing Maintenance. Industrial Press.*
10. *Yokota, H., Nagai, K., Matsumoto, K., & Mon, Y. Y. (2017). Prospect for implementation of road infrastructure asset management. Advanced Engineering Forum, 21, 366–372. https://doi.org/10.4028/www.scientific.net/aef.21.366*