Exploring Asset Management System Alignment with ISO 55001: A Qualitative Framework Analysis of an Electric Cooperative

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Abstract

Asset-intensive electric utilities require systematic asset management practices to sustain service reliability, control operational risk, and support long-term infrastructure performance. This study assessed the alignment of the asset management system of a selected electric cooperative in Zambales, Philippines with ISO 55001:2024, focusing on Clauses 6 to 10: Planning, Support, Operation, Performance Evaluation, and Improvement. A qualitative case study design using framework analysis was employed. Data were gathered through semi-structured interviews with four key personnel involved in planning, operation, maintenance, monitoring, and documentation, and were supported by available documentary evidence. Interview and documentary data were organized using a clause-based matrix and interpreted according to ISO 55001:2024 Clauses 6 to 10. Findings showed that the cooperative had functional practices in risk assessment, budgeting, maintenance execution, communication, performance monitoring, and corrective response. However, implementation remained inconsistent because planning documents were fragmented, a consolidated Strategic Asset Management Plan was absent, records management was decentralized, competence development was partly informal, internal audit practices were not consistently programmed, and improvement records lacked systematic root-cause and effectiveness documentation. The study concludes that the major implementation gap is not the absence of asset-related activities but the limited control of documented information that links planning, operation, performance evaluation, and improvement. The assessment was not intended as a formal ISO certification audit but as an academic framework analysis of department-level practices. The study demonstrates the usefulness of ISO 55001 as a diagnostic framework for strengthening asset management maturity in resource-constrained electric cooperatives.

Keywords: asset management system; documented information; electric cooperative; ISO 55001; operational control; qualitative framework analysis

1 Introduction

Electric cooperatives operate in asset-intensive environments where electricity distribution reliability depends on the effective planning, operation, maintenance, monitoring, renewal, and improvement of physical infrastructure. Distribution lines, substations, transformers, poles, meters, and related facilities require systematic management because their condition directly affects service continuity, public safety, operational cost, regulatory performance, and consumer satisfaction (Hastings, 2016; Shaghaghi et al., 2024). In this context, asset management is not limited to maintenance work but serves as a management discipline that

connects technical decisions with organizational objectives, risk priorities, resource allocation, performance evaluation, and long-term value creation (Almeida et al., 2022; International Organization for Standardization [ISO], 2024a, 2024b).

The ISO 55000 family of standards provides a globally recognized framework for asset management. ISO 55001 specifies the requirements for establishing, implementing, maintaining, and improving an asset management system (ISO, 2024b). These requirements guide organizations in defining asset management objectives, addressing risks and opportunities, providing support resources, controlling operations, evaluating performance, and pursuing continual improvement. The 2024 revision further reinforces the importance of documented information, data and information management, knowledge management, lifecycle thinking, and evidence-based decision-making (ISO, 2024a, 2024b). For electric utilities, ISO 55001 is particularly relevant because distribution assets are geographically dispersed, capital-intensive, exposed to operational and environmental risks, and expected to support reliable service over long periods.

Asset management implementation is increasingly recognized as a system-wide organizational concern rather than a purely technical or maintenance-centered function. Katina et al. (2021) positioned asset management within a complex system governance perspective, emphasizing that asset-related outcomes are shaped by the interaction of organizational structures, decision processes, stakeholders, resources, and technical systems. Alsyouf et al. (2021) likewise found that ISO 55000 implementation can positively affect organizational performance across financial, customer, internal process, and learning-growth perspectives when properly institutionalized.

Recent studies also emphasize that asset management effectiveness depends on lifecycle integration, maintenance-system alignment, asset data governance, and organizational readiness. De Almeida Pais et al. (2021) emphasized that physical asset lifecycle optimization requires integrated evaluation of maintenance, investment, technology, and sustainability decisions. Da Silva and de Souza (2022) argued that maintenance should be connected to broader asset management objectives rather than treated as an isolated technical function. Gavrikova et al. (2022) showed that asset data management is critical in power companies because data quality, accessibility, and governance affect planning, reliability, and decision-making. Da Cruz et al. (2024) further identified asset management difficulties related to documentation, data, organizational capability, process maturity, and culture. Similarly, Konstantakos et al. (2024) found that small-to-medium water utilities implementing ISO 55001 experienced strengths and weaknesses across the standard's requirements, reinforcing the need to examine how utility organizations translate asset management system requirements into actual organizational practices.

Despite these contributions, limited research has examined how ISO 55001 requirements are translated into daily operational practices within Philippine electric cooperatives. Existing studies often focus on organizational-level maturity, certification, digitalization, maintenance optimization, or broad performance outcomes. Less attention has been given to department-level implementation in technical units responsible for planning, construction, operation, maintenance, monitoring, and documentation. This gap is significant because ISO 55001 implementation depends not only on the existence of asset-related activities but also on controlled documented information showing that these activities are planned, performed, evaluated, reviewed, and improved.

In the Philippine electric power sector, distribution utilities are expected to plan infrastructure requirements and maintain reliable electricity service through distribution development planning. The Department of Energy describes the Distribution Development Plan as the annual program of distribution utilities for identifying infrastructure requirements and ensuring continuity, reliability, and affordability of electricity service to consumers (Department of Energy [DOE], 2024). Electric cooperatives also operate within a governance environment shaped by the National Electrification Administration Reform Act of 2013, which introduced structural reforms for the National Electrification Administration and electric cooperatives (Republic Act No. 10531, 2013), and the Electric Power Industry Reform Act of 2001, which restructured the Philippine electric power industry (Republic Act No. 9136, 2001). These regulatory and planning conditions make asset

management particularly relevant for electric cooperatives, where infrastructure reliability, lifecycle planning, documentation, and accountability are closely connected to public service delivery.

This study assessed the asset management system of a selected electric cooperative in Zambales, Philippines using ISO 55001:2024 as the analytical framework. The Technical Services Department was selected as the unit of analysis since it performs major asset-related functions, including planning, construction, operation, inspection, maintenance, monitoring, and improvement of electricity distribution assets. The assessment focused on Clauses 6 to 10 of ISO 55001:2024, namely Planning, Support, Operation, Performance Evaluation, and Improvement.

This study contributes to the literature by providing a department-level qualitative framework assessment of ISO 55001 alignment in a Philippine electric cooperative. It highlights the role of controlled documents in distinguishing routine asset-related activities from an integrated asset management system. The study also provides empirical grounding for improvement actions that may help electric cooperatives strengthen asset management maturity without immediately pursuing formal ISO certification.

1.1. Objectives of the Study

This study assessed the alignment of asset management practices in the Technical Services Department of a selected electric cooperative in Zambales, Philippines with ISO 55001:2024.

Specifically, the study sought to answer the following questions:

1. How do the asset management practices of the Technical Services Department align with ISO 55001:2024 Clauses 6 to 10?
2. What implementation gaps are evident in relation to ISO 55001-aligned asset management practices?
3. What challenges affect the institutionalization of asset management practices in the Technical Services Department?

2 Methodology

This study employed a qualitative case study design using framework analysis to assess the alignment of asset management practices with ISO 55001:2024. This design was appropriate because the inquiry examined implementation gaps and documentary evidence within a specific organizational setting (Yin, 2018; Creswell & Poth, 2018). The study was conducted in a selected electric cooperative in Zambales, Philippines, with the Technical Services Department serving as the unit of analysis because of its direct involvement in asset planning, construction, operation, maintenance, monitoring, documentation, and system improvement. This departmental focus allowed the study to examine how ISO 55001 requirements were reflected in actual technical and operational practices rather than only in organization-level policy statements.

Four key personnel were selected through purposive sampling based on their direct involvement in asset-related decision-making, implementation, documentation, and oversight. Although the number of participants was limited, the participants were considered appropriate because they served as process owners or system custodians with direct knowledge of the practices being examined. Table 1 summarizes the participants' functional roles and their relevance to the study. Their combined roles provided cross-functional insight into the planning, execution, monitoring, and documentation processes needed to assess ISO 55001 alignment within the department.

Table 1. Participant profile and role relevance

Participant code	Functional role	Relevance to the study
P1	Technical Services leadership/management function	Provided information on department-level planning, risk assessment, resource constraints, decision-making, and coordination.
P2	Asset management-related supervisory function	Provided information on asset records, maintenance planning, asset monitoring, and documentation practices.
P3	Construction, operation, and maintenance-related supervisory function	Provided information on operational execution, maintenance activities, field practices, and contractor-related work.
P4	Planning, design, and systems-related engineering function	Provided information on planning, technical data, digital systems, regulatory requirements, and performance monitoring.

Data were gathered through semi-structured interviews and review of available documentary evidence. The interview guide was aligned with ISO 55001:2024 Clauses 6 to 10, covering planning, support, operation, performance evaluation, improvement, and implementation challenges. ISO 55001:2024 specifies the requirements for establishing, implementing, maintaining, and improving an asset management system, making it suitable as the assessment framework for the study (International Organization for Standardization [ISO], 2024b). The guide was also informed by recent ISO 55001 implementation literature, particularly studies emphasizing implementation barriers, documentation burden, organizational capability, and the translation of asset management requirements into utility practice (Maletič et al., 2023; Konstantakos et al., 2024). Documentary evidence included available plans, risk-related documents, maintenance-related records, monitoring reports, regulatory documents, audit-related evidence, communication records, and other asset management-related documents provided or referenced during the study. Document analysis was used to verify, support, or qualify interview responses, consistent with the use of documents as evidence in qualitative inquiry (Bowen, 2009).

Data analysis followed the stages of framework analysis, which is appropriate for applied qualitative studies that use a predetermined analytical structure to organize, chart, compare, and interpret data (Ritchie & Spencer, 1994; Gale et al., 2013). Interview responses were transcribed, translated into English when necessary, and reviewed for familiarization. The data were then organized according to ISO 55001:2024 Clauses 6 to 10, which served as the a priori analytical framework for assessing planning, support, operation, performance evaluation, and improvement practices (ISO, 2024b). A clause-based analytical matrix was used to compare interview accounts with documentary evidence and to identify recurring implementation patterns, alignment evidence, and gaps. Methodological triangulation through interviews and documentary evidence was applied to strengthen credibility and reduce reliance on a single data source (Carter et al., 2014).

Each clause area was assessed using predefined alignment categories, guided by asset management maturity concepts to provide additional context for interpreting the extent of implementation (Institute of Asset Management [IAM], 2020). “Aligned” referred to a condition where interview and documentary evidence confirmed consistent implementation of the relevant ISO 55001 requirement. “Partially aligned” referred to a condition where a practice existed and was supported by some evidence, but documentation, implementation, integration, monitoring, or review was incomplete, indicating an intermediate level of maturity. “Emerging alignment” referred to a condition where an initial, informal, or developing practice existed but was not yet standardized, controlled, or consistently evidenced, corresponding to an early stage of maturity. “Not aligned” referred to a condition where no sufficient practice or documentary evidence was found to support the relevant requirement. These categories were used as analytical descriptors for academic assessment and were not intended to represent formal ISO certification findings or a formal IAM maturity assessment.

Figure 1 summarizes the data analysis procedure used in the study, from transcription and translation of interview responses to participant validation of the synthesized findings.

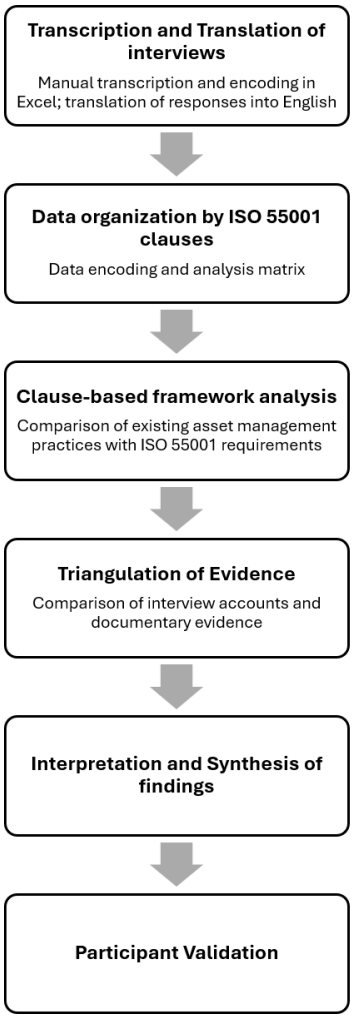

Fig 1. Data analysis procedure using qualitative framework analysis.

Ethical considerations were observed throughout the study. Participation was voluntary, and participants were informed of the purpose of the research and their right to decline or withdraw. Participant identifiers were replaced with codes, and the name of the electric cooperative was not disclosed to protect organizational confidentiality. The study was not intended to serve as a formal ISO certification audit but as an academic framework analysis of department-level asset management practices. Trustworthiness was strengthened through triangulation, participant checking, use of a clause-based analytical matrix, and clear documentation of the analytical process.

3 Results and Discussion

The findings showed that the Technical Services Department had several asset management practices relevant to ISO 55001:2024 requirements. However, these practices were unevenly documented, inconsistently controlled, and not fully integrated into a complete asset management system. The main issue was not the absence of asset-related work, but the limited availability of controlled, traceable, and audit-ready documented information linking planning, support, operation, performance evaluation, and improvement activities.

Table 2 provides an overview of the existing practices, major gaps, and corresponding alignment assessment for each ISO 55001 clause area. The detailed clause-level findings are discussed in the succeeding subsections.

3.1 Clause 6: Planning

The Technical Services Department had existing planning practices, including vulnerability and risk assessment, asset risk categorization, resiliency compliance planning, emergency restoration planning, budgeting, and capital expenditure planning. These practices were relevant to ISO 55001 because the standard requires organizations to determine risks and opportunities affecting asset management outcomes, plan actions to address them, and integrate these actions into asset management planning (International Organization for Standardization [ISO], 2024b). High-risk assets were assessed based on exposure to natural and hazard risks, and mitigation plans were prepared when needed. These practices demonstrated partial alignment with ISO 55001 requirements on actions to address risks and opportunities, particularly where asset-related risks were identified and supported by resiliency or mitigation outputs.

Table 2. Summary of ISO 55001 alignment findings

ISO 55001 clause	Existing practices identified	Main gap identified	Alignment assessment
Clause 6: Planning	Risk assessment, resiliency planning, emergency restoration planning, budgeting, capital expenditure planning, and three-year planning.	No consolidated SAMP; fragmented planning documents; weak traceability among objectives, risks, resources, and actions.	Partially aligned to emerging alignment.
Clause 7: Support	Budgeting, onboarding, supplier training, internal communication, regulatory reporting, and knowledge transfer.	Staffing gaps, informal competence development, decentralized records, weak document control, and limited data governance.	Emerging to partially aligned.
Clause 8: Operation	In-house routine field work, outsourced major maintenance, procurement and bidding practices, and post-qualification activities.	Maintenance-centered records; limited lifecycle documentation beyond maintenance; weak change-control evidence.	Partially aligned.
Clause 9: Performance Evaluation	Monitoring of expenditures, system losses, downtime, safety, regulatory outputs, departmental updates, and management meetings.	No fully documented KPI framework, irregular internal audit program, and limited management review evidence and action tracking.	Emerging to partially aligned.
Clause 10: Improvement	Immediate corrective responses, repair of damaged assets, costing, cost recovery, and practical corrective action.	Weak NCR/CAR system, limited root-cause analysis, limited effectiveness checks, and limited lessons-learned records.	Emerging alignment.

One participant explained that the cooperative conducted vulnerability and risk assessments for assets exposed to natural and hazard risks. Installed poles, for instance, were assessed for exposure to flooding or tsunami, and high-risk cases could trigger resiliency compliance and mitigation planning. This indicated that risk-oriented planning existed and that some outputs were prepared for regulatory and operational purposes. Such practices are consistent with the risk-based orientation of asset management, where asset decisions should consider risk, performance, cost, and value across the asset life cycle (Almeida et al., 2022; Hastings, 2016; ISO, 2024b).

However, planning was not fully integrated into a controlled asset management planning system. The study found no consolidated Strategic Asset Management Plan within the Technical Services Department. Existing documents, such as capital expenditure plans and three-year plans, served as planning references but did not function as an integrated SAMP linking asset management objectives, lifecycle strategies, decision criteria, resource requirements, risk priorities, and improvement programs. One participant noted that there was no single document within Technical Services containing the complete asset management direction, although planning documents existed. This gap is significant because ISO 55001 identifies the SAMP as a key planning mechanism for aligning asset management objectives, decision-making, required capabilities, contingencies, and improvement approaches with organizational and financial plans (ISO, 2024b).

As a result, planning evidence was fragmented, and traceability between strategic intent and operational execution remained limited. Planning was practiced, but it was not consistently expressed through a controlled, integrated, and periodically reviewed asset management planning document. The absence of an integrated SAMP is important because lifecycle asset management requires the alignment of maintenance, investment, technology, risk, and sustainability considerations (de Almeida Pais et al., 2021). Similar implementation issues have been reported in asset management system studies, where organizations may have existing maintenance,

budgeting, and operational practices but still experience difficulty integrating these practices into a documented and auditable management system because of resource, documentation, and organizational capability constraints (Konstantakos et al., 2024; Maletič et al., 2023).

3.2 Clause 7: Support

Support practices were present but unevenly institutionalized. The department had budgeting processes, onboarding, supplier-led training, internal communication channels, regulatory reporting practices, and knowledge transfer through supervisors and co-workers. Communication was active through meetings, memoranda, and digital messaging platforms. These practices were relevant to ISO 55001 because Clause 7 requires organizations to determine and provide resources, ensure competence, promote awareness, establish communication arrangements, control documented information, manage data and information, and retain organizational knowledge needed for effective asset management system implementation (ISO, 2024b).

Several support gaps were identified. Staffing constraints and unfilled positions resulted in workload redistribution and delays in meeting planned targets. Participants reported that some positions remained vacant and that certain personnel continued performing previous tasks even after role changes or promotion. These conditions affected workload distribution, role clarity, documentation accountability, and target completion. This finding is consistent with asset management implementation literature showing that limited resources, unclear role allocation, and organizational capability constraints can weaken the institutionalization of asset management systems (Maletič et al., 2023; Konstantakos et al., 2024).

Competence development was partly informal, especially for digital systems such as GIS and SCADA. While onboarding and supplier-led training existed, role-based competency requirements, competence matrices, periodic assessments, and professional development plans were not consistently documented. Some learning related to software and digital tools was self-directed. This condition limits the ability of the organization to verify whether personnel performing asset-related functions possess and maintain the necessary competence. ISO 55001 requires organizations to determine necessary competence, ensure personnel are competent, take action to acquire needed competence, and maintain appropriate evidence of competence (ISO, 2024b). In asset-intensive organizations, competence development is particularly important because asset management increasingly depends on reliable data, digital systems, lifecycle analysis, and coordinated decision-making (Biard & Nour, 2021; Maletič et al., 2023).

Documented procedures and data governance were among the weakest support areas. File management was largely decentralized, document ownership was unclear, and there was limited evidence of systematic version control, controlled-copy distribution, document classification, retention rules, access control, and secure disposal. Data and information management were developing but were not yet supported by formal data standards, quality checks, repository rules, and financial-technical traceability. This finding supports Gavrikova et al. (2022), who emphasized that asset data management is critical in power companies because data quality and accessibility influence planning, reliability, and decision-making. These gaps limited the department's ability to demonstrate that support processes were consistently controlled, retrievable, and linked to asset management decision-making. Overall, Clause 7 showed emerging to partial alignment. Support mechanisms existed, but their effectiveness was constrained by staffing limitations, informal competence systems, decentralized documentation, and underdeveloped data governance. These findings suggest that support functions must be formalized not only as administrative activities but also as enabling controls that sustain asset management planning, operational consistency, performance evaluation, and continual improvement (ISO, 2024b; Alsyouf et al., 2021).

3.3 Clause 8: Operation

Operational practices were more readily observable than planning and support controls because routine field activities, maintenance work, and outsourced project-based activities were directly reflected in day-to-day technical operations. Routine asset-related works, such as line works, pole replacement, transformer replacement, and field activities, were generally performed in-house. Major project-based works, particularly preventive and corrective maintenance of substations, were outsourced through procurement and bidding processes. Supplier involvement and post-qualification activities were also reported. These practices were relevant to ISO 55001 because Clause 8 requires organizations to plan, implement, and control operational processes, including lifecycle processes, externally provided activities, and changes that may affect asset management outcomes (ISO, 2024b).

Participants described a practical distinction between regular internal work and outsourced project-based work. Routine activities handled by field personnel were generally performed internally, while major substation preventive and corrective maintenance activities were commonly outsourced. Supplier-led training was also used when new equipment was introduced. These practices indicated operational capability and partial alignment with ISO 55001. The presence of maintenance execution and contractor-supported work reflects the operational nature of asset management in infrastructure organizations, where maintenance, outsourcing, and work control must be coordinated with asset objectives and service requirements (Hastings, 2016; Da Silva & de Souza, 2022).

However, the available evidence mainly supported maintenance execution and procurement-linked activities. The documentation did not fully demonstrate lifecycle management beyond maintenance, including asset renewal criteria, disposal controls, replacement prioritization, and long-term asset retirement planning. This limitation is important because lifecycle asset management requires organizations to integrate maintenance, renewal, investment, technology, and sustainability decisions across the life of physical assets (de Almeida Pais et al., 2021). In electric distribution systems, aging assets and long-lived infrastructure also require systematic condition assessment, renewal planning, and risk-based prioritization to maintain reliability and service continuity (Shaghaghi et al., 2024).

Change-control evidence was also limited. Modernization efforts, including GIS and SCADA utilization, were recognized, but the study found limited evidence of a standardized change-control process with impact assessment, approval, implementation records, unintended-consequence review, and post-change evaluation. This is relevant because digitalization and Industry 4.0 technologies can support asset management in the electrical industry, but their value depends on proper integration with organizational processes, asset data, and decision-making controls (Biard & Nour, 2021; Gavrikova et al., 2022). Thus, the department demonstrated functional operational execution, particularly in maintenance and procurement-linked work, but lifecycle-based operational control and change governance remained underdeveloped. This finding is consistent with Da Silva and de Souza (2022), who argued that maintenance management should be structured according to ISO 55000 principles and connected to broader asset management objectives.

3.4 Clause 9: Performance Evaluation

The cooperative monitored several indicators relevant to asset management, including capital expenditures, operational expenditures, system losses, downtime, safety incidents, regulatory outputs, and departmental progress. Performance reporting was supported through management meetings and departmental updates. These practices showed that performance-related information was being generated and discussed. Such monitoring activities were relevant to ISO 55001 because Clause 9 requires organizations to determine what needs to be monitored and measured, how and when monitoring should be conducted, how results should be analyzed and evaluated, and how performance information should be retained as documented evidence (ISO, 2024b).

Despite these practices, performance evaluation was not yet organized as a fully controlled system. The study found limited evidence of KPI definition sheets, assigned data owners, data validation rules, analysis methods, escalation protocols, and formal action tracking. This gap is significant because performance information should support decision-making, prioritization, and improvement, not merely serve as periodic reporting. Asset data management is especially important in power companies because data quality, accessibility, and governance influence planning, reliability, and asset-related decisions (Gavrikova et al., 2022). Similarly, value-based infrastructure asset management requires performance information that links asset decisions with organizational value, stakeholder expectations, and long-term service outcomes (Almeida et al., 2022).

Internal audits existed but were described as irregular and sometimes negatively perceived because their purpose and improvement value were not always clearly communicated. Management review was conducted through meetings and reporting practices, but the documentation of review inputs, decisions, responsibilities, due dates, and closure evidence was limited. These limitations matter because ISO-aligned asset management requires not only monitoring but also structured internal audit and management review processes that provide evidence of system suitability, adequacy, effectiveness, and continual improvement (ISO, 2024b). ISO 19011 also emphasizes that audits should be planned, objective, evidence-based, and useful for evaluating management system implementation and improvement opportunities (International Organization for Standardization, 2018).

Accordingly, Clause 9 showed emerging to partial alignment. Monitoring and review practices existed, but they were not yet supported by a complete performance evaluation framework and audit-ready evidence trail. This gap is important because ISO-aligned asset management should demonstrate organizational value, not only technical maintenance. Alsyouf et al. (2021) found that ISO 55000 implementation can positively affect organizational performance, which supports the need for performance evaluation structures that connect asset activities with cost, reliability, process effectiveness, customer outcomes, and organizational learning. Recent implementation studies also show that organizations may recognize the value of asset management systems but still encounter barriers related to documentation burden, resource limitations, and process maturity when translating performance information into systematic management control (Maletič et al., 2023; Da Cruz et al., 2024).

3.5 Clause 10: Improvement

Corrective action practices were observed in operational responses. These included immediate repair of damaged assets, preparation of bills of materials and labor costs, and cost recovery from responsible parties when applicable. These practices showed that the department responded to operational issues and incidents. Such responses were relevant to ISO 55001 because Clause 10 requires organizations to improve the suitability, adequacy, and effectiveness of the asset management system and to respond to nonconformities or incidents through correction, root-cause evaluation, corrective action, and effectiveness review (ISO, 2024b).

However, improvement practices were not yet institutionalized as a formal continual improvement system. The study found limited evidence of structured nonconformity reporting, root-cause analysis, corrective action planning, effectiveness verification, closure documentation, trend analysis, and lessons-learned records. Some corrective actions were performed as practical operational responses, but they were not consistently converted into documented improvement records that could support recurring analysis and organizational learning. This distinction is important because asset management improvement requires more than solving immediate technical problems; it requires capturing lessons, evaluating causes, preventing recurrence, and linking corrective actions to management review and performance evaluation (ISO, 2024b; Hastings, 2016).

Clause 10 was therefore assessed as emerging alignment. Corrective response existed, but a structured improvement system was not yet fully established. This indicates that the cooperative's practical ability to respond to issues should be strengthened through a formal nonconformity and corrective action system that

records problems, identifies causes, assigns actions, checks effectiveness, and captures lessons learned. This finding is consistent with asset management implementation literature showing that organizations often encounter difficulty institutionalizing asset management systems when documentation, resources, process maturity, and organizational learning mechanisms are underdeveloped (Maletič et al., 2023; Da Cruz et al., 2024). It also supports utility-based ISO 55001 research indicating that implementation strength depends not only on technical practices but also on the organization's ability to standardize, document, review, and improve those practices over time (Konstantakos et al., 2024).

3.6 Challenges affecting ISO-aligned asset management implementation

The study identified six cross-cutting challenges that affected the institutionalization of ISO-aligned asset management practices. These challenges cut across planning, support, operation, performance evaluation, and improvement, and help explain why existing asset-related activities were not consistently converted into verifiable management-system evidence.

Table 3. Challenges affecting ISO-aligned asset management implementation

Challenge	Observed condition	Effect on ISO alignment
Procedure gaps and documentation weaknesses	Recurring asset-related cases were often handled through experience and common practice rather than documented procedures.	Reduced consistency, traceability, and audit readiness.
Staffing constraints and vacancies	Unfilled positions and role overlaps resulted in workload redistribution and missed targets.	Weakened resource adequacy, role accountability, and continuity of documentation.
Uneven competence development	Onboarding and supplier training existed, but role-based competence requirements and digital-systems training were limited.	Reduced assurance that personnel consistently met required competence for asset management tasks.
Procurement lead times	Compliance and bidding processes extended the time needed to obtain materials and services.	Affected operational responsiveness and implementation of planned work.
Financial liquidity and fund access	Small but urgent needs depended on petty cash, credit arrangements, or approval-based fund access.	Constrained timely execution of routine and urgent asset-related work.
Data and records governance gaps	Records were decentralized, and data standards, retention rules, and repository controls were limited.	Limited evidence retrieval, decision traceability, and management review reliability.

As shown in Table 3, the challenges were multidimensional and involved procedural, human resource, financial, procurement, and information governance concerns. Procedure gaps and documentation weaknesses limited the consistency and traceability of recurring asset-related activities. Staffing constraints and role overlaps affected workload distribution, accountability, and continuity of documentation. Uneven competence development also limited the organization's ability to verify whether personnel consistently possessed the required knowledge and skills for asset-related tasks, particularly those involving digital systems.

Procurement lead times and financial liquidity constraints further affected operational responsiveness. Although these concerns were not purely technical, they influenced the timely execution of maintenance, replacement, and other asset-related activities. Data and records governance gaps also limited the availability of reliable evidence for monitoring, management review, audit, and improvement. These findings support Da Cruz et al. (2024), who found that asset management difficulties are shaped by organizational, technical, process, and capability-related factors.

Overall, the findings indicate that improving ISO 55001 alignment cannot be achieved simply by producing more documents. The electric cooperative must also strengthen role clarity, competence development, audit culture, procurement coordination, data governance, and management review discipline. A documentation and control system may serve as a practical entry point, but it must be supported by leadership commitment, staff orientation, repository governance, and periodic verification to become an effective asset management control mechanism.

4 Conclusions and recommendations

4.1 Conclusions

This study assessed the alignment of asset management practices in the Technical Services Department of a selected electric cooperative in Zambales, Philippines with ISO 55001:2024 using qualitative framework analysis. The findings showed that the department had functional asset management practices related to risk assessment, budgeting, maintenance execution, internal communication, monitoring, reporting, and corrective response. However, these practices showed only partial or emerging alignment with ISO 55001 because they were not consistently supported by controlled documentation, integrated planning, structured data governance, formal competence systems, planned internal audits, and systematic improvement records.

Across Clauses 6 to 10, the most evident implementation gap was the limited control and traceability of documented information. Planning, support, operation, performance evaluation, and improvement practices were present, but they were not consistently connected through a consolidated SAMP, controlled document and records system, formal competence framework, lifecycle-based operational controls, KPI structure, internal audit program, management review records, and corrective action tracking.

The study concludes that the central issue was not whether asset-related work was being performed, but whether such work was institutionalized as part of a documented, traceable, and continuously improving asset management system. The cooperative demonstrated practical operational capability, especially in maintenance, risk response, and regulatory reporting. However, these practices need stronger integration through controlled system documentation, lifecycle planning, performance evaluation, audit, and improvement mechanisms. Strengthening these areas would allow the organization to better demonstrate how asset management activities contribute to reliability, risk control, resource optimization, regulatory accountability, and long-term value creation.

The findings contribute to ISO 55001 implementation literature by showing how a department-level qualitative framework analysis can reveal the difference between performing asset-related activities and operating an integrated asset management system. For resource-constrained electric cooperatives, ISO 55001 may serve not only as a certification standard but also as a practical diagnostic framework for identifying documentation, planning, monitoring, and improvement priorities.

4.2 Recommendations

The recommendations are organized according to the major ISO 55001 functions assessed in the study: planning, support, operation, performance evaluation, and improvement.

Based on the findings, the selected electric cooperative should prioritize the development of a consolidated Strategic Asset Management Plan that links asset management objectives, risk priorities, lifecycle strategies, capital expenditure planning, maintenance programs, performance measures, and improvement actions. This document should serve as the central planning reference for aligning strategic intent with operational execution within the Technical Services Department.

The cooperative should establish a formal documented information procedure covering document ownership, version control, controlled-copy distribution, retention, access, classification, and disposal. This procedure should clarify responsibility for preparing, reviewing, approving, storing, updating, and retrieving asset

management documents and records. Strengthening system documentation control would improve traceability, reduce dependence on informal file management, and support audit readiness.

To strengthen support mechanisms, the cooperative should define role-based competence requirements, prepare competence matrices, document training plans, and periodically evaluate competence for personnel involved in asset-related functions. Particular attention should be given to personnel handling GIS, SCADA, and other digital systems because these tools require sustained technical capability and reliable data management.

For operational control, the cooperative should formalize lifecycle-based procedures for asset maintenance, renewal, replacement, disposal, outsourced work, and change management. Change-control documentation should include impact assessment, approval, implementation records, review of unintended consequences, and post-change evaluation. Outsourced activities should also be linked to documented performance requirements and post-completion evaluation.

For performance evaluation, the cooperative should establish KPI definition sheets, assign data owners, define data validation rules, document analysis methods, and maintain action-tracking records. Internal audits and management reviews should be scheduled, documented, and communicated as improvement-oriented activities rather than fault-finding exercises. The cooperative should also institutionalize a nonconformity and corrective action system that records problems, identifies root causes, assigns corrective actions, verifies effectiveness, and captures lessons learned for future planning and improvement.

Limitations and Future Research

This study was limited to one electric cooperative and focused only on the Technical Services Department. The findings are context-specific and are not intended for statistical generalization. The study relied on interviews and available documentary evidence; therefore, some findings may have been affected by limited document access. The absence of documentary evidence in some areas may indicate either nonexistence of records or restricted availability during the study period.

The study did not include direct observation of maintenance, audit, document-control, or management review activities. It also did not quantitatively test the relationship between documentation gaps and operational indicators such as outage frequency, maintenance cost, downtime, or service reliability. Future studies may extend the assessment to other departments, such as finance, procurement, corporate planning, human resources, internal audit, and general management, to provide a broader organization-wide assessment. Comparative studies across several electric cooperatives may also be conducted to identify common ISO 55001 readiness patterns in the Philippine electric distribution sector. In addition, future research may evaluate the implementation of a documented information procedure as an intervention for improving ISO 55001 alignment.

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