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Analysis of the Requirements for an Internet of Things-Based Predictive Monitoring System Using a Requirements Engineering Approach at Gas-Fired Power Plants (PLTMG): A Case Study of Tual City and Southeast Maluku Regency

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Keyword
Requirements Engineering; Internet of Things; Predictive Monitoring; System Requirements Specification; Requirement Traceability Matrix.

Abstract
The operational reliability of Gas Engine Power Plants (PLTMG) depends on monitoring systems capable of providing accurate information regarding equipment conditions. However, operational data remain distributed across multiple sources, limiting the implementation of integrated predictive monitoring systems. This study aimed to analyze the requirements of an Internet of Things (IoT)-based predictive monitoring system using a Requirements Engineering approach. A descriptive qualitative method was employed through observations, interviews, and operational document analysis. The results identified six candidate requirements, which were refined into ten system requirements. Using the MoSCoW prioritization method, the requirements were classified into six Must-have (60%), three Should-have (30%), and one Could-have (10%) categories. The prioritized requirements were documented in a System Requirements Specification (SRS) and validated using a Requirement Traceability Matrix (RTM). The analysis indicated that the identified system requirements could improve data availability, monitoring capabilities, analytical capabilities, maintenance decision-making effectiveness, equipment reliability, and power plant availability. This study produced Requirements Engineering artifacts, including the SRS, RTM, conceptual architecture, and Causal Loop Model (CLM), which provide references for developing IoT-based predictive monitoring systems in PLTMG and serve as a foundation for similar studies.

INTRODUCTION

The reliability of electric power generation systems is a critical factor in ensuring energy supply continuity, operational efficiency, and sustainable electricity services (Priyanti et al., 2024). In Gas Engine Power Plants (PLTMG), operational continuity is strongly influenced by the ability of the system to continuously monitor equipment conditions, enabling potential disturbances to be detected before they develop into system failures (Yusrizal et al., 2024). Delays in identifying changes in operating conditions may increase the risk of unplanned shutdowns, higher maintenance costs, reduced generation efficiency, and decreased power system reliability (Priyanti et al., 2024). Therefore, the availability of monitoring systems capable of providing accurate, continuous, and accessible operational information is essential for supporting power plant operation and maintenance activities (Yusrizal et al., 2024). Previous studies on fuel consumption optimization, protection system evaluation, and PLTMG reliability analysis have demonstrated that high-quality monitoring data play an important role in improving power plant performance (Domínguez-Bolaño et al., 2022; Priyanti et al., 2024; Yusrizal et al., 2024).

The advancement of the Industrial Internet of Things (IIoT) has transformed industrial monitoring systems through the integration of sensors, communication devices, edge computing, cloud computing, and analytics platforms, enabling real-time data acquisition, storage, and processing (Upadhyay et al., 2024). In the energy sector, IIoT technologies have been applied to power generation systems, transformers, smart grids, and Supervisory Control and Data Acquisition (SCADA) systems to improve asset condition visibility, accelerate fault detection, and support data-driven decision-making (Kaur et al., 2024; Msane et al., 2024). Furthermore, IIoT implementation in energy systems requires attention to data and communication security because increased device connectivity may increase exposure to cybersecurity risks affecting monitoring systems (Ferlito et al., 2024). The integration of diverse operational data sources provides a foundation for developing more adaptive, efficient, and reliable monitoring systems (Upadhyay et al., 2024).

Alongside the development of IIoT technology, various studies have investigated Internet of Things (IoT)-based monitoring systems for power plants, generators, transformers, and other energy infrastructure (Murtazaa et al., 2024; Waqas & Jamil, 2024). These studies have addressed topics including monitoring system architecture development, SCADA integration, data communication, cybersecurity, condition monitoring, and predictive maintenance using analytical techniques and machine learning approaches (Ardebili et al., 2024; Isrofiasrory et al., 2026). Research findings have indicated that IoT implementation improves asset condition monitoring capabilities and supports early fault detection (Sun et al., 2024; Waqas & Jamil, 2024). However, most existing studies have focused primarily on technology implementation and post-development system performance evaluation (Ardebili et al., 2024). Consequently, activities such as user needs identification, requirements analysis, specification development, and requirements validation before the system development phase have received limited attention (Ardebili et al., 2024).

Based on the literature synthesis, previous research can be categorized into three main trends: the development of IoT architectures for industrial monitoring; SCADA integration and data communication in energy systems; and the application of condition monitoring and predictive maintenance using analytical methods and artificial intelligence (Aslam et al., 2024; Kocak & Abut, 2024; Linker & Brown, 2021). These research areas have contributed significantly to advances in monitoring technologies (Aslam et al., 2024). Nevertheless, because most studies emphasize system implementation, the processes of identifying user needs, analyzing requirements, developing specifications, and validating requirements before system development have not been systematically addressed (Linker & Brown, 2021). Consequently, system requirements that serve as the foundation for development often lack formal documentation and sufficient traceability (Linker & Brown, 2021). This gap highlights the importance of applying Requirements Engineering (RE) as an initial stage in developing IoT-based monitoring systems (ISO/IEC/IEEE 29148, 2018; Wagner et al., 2018).

Requirements Engineering is a systematic approach for identifying, analyzing, documenting, validating, and managing system requirements before the design and implementation phases (Wagner et al., 2018). This approach ensures that requirements are clearly defined, formally documented, and traceable, thereby reducing the risk of misalignment between the developed system and operational needs (ISO/IEC/IEEE 29148, 2018).

A review of previous research indicates that most studies have focused on implementing IoT-based predictive monitoring technologies through the development of hardware, prediction algorithms, or monitoring platforms. However, studies specifically applying Requirements Engineering (RE) to generate documented, validated, and traceable system requirements before implementation remain limited (Cheng et al., 2026; Elapolu et al., 2024; Mucha et al., 2024). Therefore, this study addressed this gap by producing RE artifacts, including candidate requirements, system requirements, a System Requirements Specification (SRS), a Requirement Traceability Matrix

(RTM), a conceptual architecture, and a Causal Loop Model (CLM), as foundations for developing an IoT-based predictive monitoring system for a PLTMG (Gas Engine Power Plant).

This research aimed to identify and analyze the requirements of an IoT-based predictive monitoring system at the PLTMG in Tual City and Southeast Maluku Regency using a Requirements Engineering approach; prioritize identified system requirements using the MoSCoW method to determine implementation priorities; document requirements in a System Requirements Specification (SRS) based on ISO/IEC/IEEE 29148:2018 standards; and validate requirements using a Requirement Traceability Matrix (RTM) to ensure traceability to operational data sources. This study provided both theoretical and practical contributions. Theoretically, it expanded Requirements Engineering research in the energy sector and provided reusable artifacts, including the SRS, RTM, conceptual architecture, and CLM, as references for similar studies. Practically, it established a documented foundation for system development, provided a roadmap for operators to improve monitoring reliability and maintenance effectiveness, and offered strategic insights for policymakers and utility companies to enhance power generation reliability, particularly in remote regions, thereby supporting electricity service continuity in Indonesia.

METHOD

Research Design

This research employed a descriptive qualitative approach by applying Requirements Engineering (RE) to analyze the requirements of an IoT-based predictive monitoring system for a Gas Engine Power Plant (PLTMG). This approach was selected because the study focused on identifying, analyzing, specifying, and validating system requirements based on operational conditions and stakeholder needs. The research produced RE artifacts, including a System Requirements Specification (SRS), a Requirement Traceability Matrix (RTM), a conceptual architecture, and a Causal Loop Model (CLM). The SRS was developed with reference to ISO/IEC/IEEE 29148:2018 while considering the structure of IEEE Std 830-1998.

Data Sources and Literature Search Strategy

To strengthen the theoretical foundation and ensure the research was grounded in relevant scientific literature, a structured literature review was conducted prior to the field research, aimed at identifying developments in research on RE, IoT, IIoT, SRS, RTM, SCADA, predictive monitoring, and condition monitoring. The literature review findings were used as the basis for developing the research's conceptual framework, determining the RE stages, and supporting the requirement-analysis process for the IoT-based predictive monitoring system.

The literature search was conducted using Google Scholar as the scientific search engine, drawing on several databases and publishers as summarized in Table 1. The initial search stage yielded 100 articles. Screening based on title relevance narrowed this to 72 articles; a further screening based on abstract, research scope, full-text availability, and publication year yielded 53 articles meeting the criteria for further review; and after a full-content evaluation, 29 articles were selected as the primary references used in this study.

Table 1. Data Sources and Literature Search Strategy

Component	Description
Data Source	Google Scholar was used as the scientific search engine to obtain literature from SpringerLink, ScienceDirect (Elsevier), IEEE Xplore, MDPI, Frontiers, arXiv, Springer Books, ISO/IEC Standards, and accredited national journals.
Literature Population	Research on Requirements Engineering, Internet of Things (IoT), Industrial Internet of Things (IIoT), System Requirements Specification (SRS), Requirement Traceability Matrix (RTM), Requirement Validation, SCADA, Predictive Monitoring, Condition Monitoring, and monitoring systems in the energy and industrial sectors.
Study Focus	Approaches, methods, frameworks, models, techniques, standards, and RE processes applied to the development of IoT-based monitoring systems.
Search Keywords	("Requirements Engineering" OR "Requirement Engineering") AND ("Internet of Things" OR IoT OR IIoT) AND ("Predictive Monitoring" OR "Condition Monitoring" OR SCADA) AND ("System Requirements Specification" OR SRS OR "Requirement Validation" OR "Requirement Traceability Matrix" OR RTM)
Publication Year	2018–2025, with exceptions for international standards and foundational references that remain relevant.
Language	English and Indonesian.
Document Type	Journal articles, conference proceedings, international standards, scientific books, and technical guidelines.

Source: Literature search strategy design (2024)

Literature Selection Process

To improve reference quality, every article obtained from the literature search was evaluated through several screening stages: title screening, abstract screening, and full-text assessment, to ensure that each reference was directly relevant to the research objective, addressed RE approaches for IoT-based monitoring systems, and came from a credible scientific source. This screening process, illustrated in a PRISMA-style flow diagram, produced 100 articles from the initial search, narrowed to 72 after title screening, 53 after abstract screening, and 29 following full-content evaluation, ensuring that all references used were relevant to the application of RE in IoT-based predictive monitoring systems.

Research Location and Object

The research was conducted at PT PLN Nusantara Power Services, Langgur PLTMG Unit, a vital facility supplying electricity to the City of Tual and Southeast Maluku Regency. The research object focused on the plant's operational monitoring process, information requirements, and operation and maintenance activities supporting the system requirement identification process.

The research data consisted of primary and secondary data. Primary data were obtained through observation of the plant monitoring process and semi-structured interviews with stakeholders involved in operations, maintenance, and instrumentation. Secondary data were obtained through document review, including operating SOPs, maintenance SOPs, SCADA

logs, disturbance reports, maintenance history, and other technical documents. The use of multiple data sources was intended to yield a comprehensive picture of system requirements while supporting the triangulation process.

Requirements Engineering Stages

This study applies the RE stages of *requirements elicitation, requirements analysis, requirements specification, requirements validation,* and *requirements management*, carried out sequentially to produce system requirements that are documented, validated, and traceable.

In the *requirements elicitation* stage, system requirements were identified through field observation, interviews with PLTMG personnel, and review of operational documents including SCADA, Data KIT, Archive Table, Alarm History, Event History, Oil Analysis, Instruction Work, and the Operation Record Engine, producing an initial list of candidate requirements representing operational and user needs. In the *requirements analysis* stage, redundancy was removed, requirements were grouped into functional and non-functional categories, conflicts between requirements were resolved, and priorities were set using the MoSCoW method. The analyzed requirements were then documented in the *requirements specification* stage in the form of an SRS following ISO/IEC/IEEE 29148:2018. The *requirements validation* stage was carried out through discussion with stakeholders to confirm that the requirements matched PLTMG's operational processes, while *requirements management* focused on developing the RTM to ensure each requirement remained traceable to its data source and system objective.

Data Analysis

Data analysis followed the RE stages. Data obtained through observation, interviews, and document review were first analyzed to identify findings related to the PLTMG monitoring system. Each finding was then screened for its relevance to the research objective—the development of an IoT-based predictive monitoring system. Findings directly related to the objective were designated as candidate requirements, while unrelated findings were not carried forward into the requirement-analysis stage. This process yielded six candidate requirements, which were subsequently analyzed into system requirements by removing redundancy, resolving conflicts, grouping requirements into functional and non-functional categories, and ensuring consistency among requirements, resulting in a complete, clear, and traceable requirement specification.

The analyzed requirements were then prioritized using the MoSCoW method (Must Have, Should Have, Could Have, and Won't Have) to determine implementation priority. The analysis results were documented in the SRS following ISO/IEC/IEEE 29148:2018 and validated using the RTM to ensure each requirement could be traced back to its data source and the established system objectives.

Requirement Analysis Criteria

Data obtained through observation, interviews, and document review were analyzed using the RE approach to produce system requirements. Before being formulated as a requirement, each piece of information was screened against four criteria—relevance to the research objective, validity of the data source, consistency across sources, and implementability as a system requirement—as presented in Table 2. This process was intended to ensure that the resulting requirements matched PLTMG's operational conditions

and could be implemented in the IoT-based predictive monitoring system. Information meeting all four criteria was deemed eligible to become a candidate requirement.

Table 2. Requirement Analysis Criteria

Criterion	Description
Relevance	Directly related to the IoT-based predictive monitoring system.
Validity	Supported by observation, interview, or operational document findings.
Consistency	Shows agreement across data sources.
Implementability	Can be translated into a system requirement.

Source: Requirement analysis framework design (2024)

Information meeting these criteria was then extracted into candidate requirements, classified into functional and non-functional requirements, prioritized using the MoSCoW method, and compiled into the SRS before being validated using the RTM. In addition, information trends were identified based on findings that recurred across multiple data sources, so that the resulting requirements reflected the most dominant operational conditions.

Data Validity

Data validity was maintained using source triangulation, comparing the results of observation, interviews, and operational document review, to ensure that the resulting system requirements did not depend on a single source of information but were supported by multiple, mutually reinforcing sources—thereby strengthening the validity of the analysis.

The triangulation results, presented in Table 3, show the common findings, unique value, and highlight of each data source. This information was used to validate the candidate requirements and to confirm that the formulated requirements rested on a consistent empirical basis relevant to PLTMG's operational conditions. Overall, the triangulation results show that the need for operational data integration, real-time information provision, and the use of historical data were the most dominant findings in the process of identifying requirements for the IoT-based predictive monitoring system.

Table 3. Data Triangulation Insight

Data Source	Common Findings	Unique Value	Highlight
Observation	Shows that monitoring still relies on multiple data sources.	Reveals the operator's actual workflow during monitoring.	Indicates the need for integration of the monitoring process.
Interview	Users need faster, more accessible information.	Describes needs and constraints felt directly by users.	Monitoring dashboard and early warning are primary needs.
SCADA	Provides generator operational data.	Displays operating parameters in real time.	Serves as the main source of automated data acquisition.
Data KIT	Provides historical operational data.	Stores equipment performance history.	Supports the need for a historical database.
Archive Table	Stores alarm and event history.	Reveals patterns of past disturbances.	Supports disturbance trend analysis.

Data Source	Common Findings	Unique Value	Highlight
Oil Analysis	Provides equipment condition information.	Reflects component health through oil analysis.	Supports condition monitoring.
Operation Record Engine	Documents machine operating activities.	Provides a chronology of operational activities.	Supports validation of generator operating conditions.

Source: Triangulation analysis of primary and secondary data (2024)

RESULTS AND DISCUSSION

Analysis of the Existing System

The initial research stage identified the condition of the monitoring system currently applied at the PLTMG in the City of Tual and Southeast Maluku Regency, as the basis for formulating the requirements of an IoT-based predictive monitoring system. Identification was carried out through field observation, interviews with operators and operations personnel, and analysis of operational documents including SCADA, Archive Table, Data KIT, Operation Record Engine, Electrical Operation Record, Standard Operating Procedures (SOP), and Instruction Work (IW), aiming to identify the gap between the existing system and the requirements of the system to be developed using the *Requirements Engineering* approach.

The observation results show that the PLTMG already uses SCADA as its primary system for real-time monitoring of engine operating conditions, supported by Data KIT, oil analysis, and communication infrastructure comprising LAN, Fiber Optic, Radio, GSM/4G, and VSAT. However, some operational data are still recorded through the Operation Record Engine and Electrical Operation Record, so information remains scattered across several media and has not yet been integrated into a single system—a condition that means monitoring, equipment-condition analysis, and maintenance decision-making still require processing data from multiple sources. Of the 29 items observed across the monitoring system, sensors and operating parameters, communication infrastructure, and IoT implementation readiness, 25 items (86.2%) were already available while 4 items (13.8%) were not, as summarized in Table 4.

Table 4. Existing Monitoring System Capability Summary

Evaluation Domain	Existing System Capability	Population	Available	Percentage
Monitoring System	SCADA, HMI, Historian Data, Alarm System, Monitoring Dashboard, Real-Time Monitoring	8	7	87.5%
Sensors and Parameters	Temperature, Pressure, Current, Voltage, Frequency, Unit Load, Fuel Consumption, Running Hours	9	8	88.9%
Communication Infrastructure	LAN, Fiber Optic, Radio, GSM/4G, VSAT	5	5	100%
IoT Implementation Readiness	Network infrastructure, sensors, human resources, management support, initial integration	7	5	71.4%

Source: Observation and document analysis results (2024)

Availability was highest for communication infrastructure (100%), followed by sensors and operating parameters (88.9%) and the monitoring system itself (87.5%), while IoT implementation readiness reached only 71.4%—indicating that further development is still needed, particularly in data integration, information digitalization, real-time monitoring capability, and analytical capability to support predictive maintenance. These findings show that the PLTMG already possesses adequate basic infrastructure but has not yet been able to provide integrated information as a foundation for implementing an IoT-based predictive monitoring system, and subsequently formed the basis for the requirements elicitation process.

Requirements Engineering Results

Once the condition of the existing system had been identified, the next stage applied RE to produce the requirements of the IoT-based predictive monitoring system, derived from observation results, interviews, SCADA data, the Archive Table, Data KIT, Oil Analysis, and operational documents. The *Requirements Elicitation* stage identified six candidate requirements representing the core needs of the predictive monitoring system Automatic Data Acquisition, Dashboard Monitoring, Real-Time Data Integration, Alarm Correlation, Historical Database, and Condition Monitoring Integration—as presented in Table 5. These six candidate requirements were obtained through analysis of observation, interview, and operational document results, then validated through triangulation with four informants; the validation results show that all candidate requirements were supported by every informant, confirming that they represent the PLTMG's operational needs.

Table 5. Requirements Elicitation Results

Source	Requirement
Observation	Automatic data acquisition
Interview	Dashboard monitoring
SCADA	Real-time data integration
Archive Table	Alarm correlation
Data KIT	Historical database
Oil Analysis	Condition monitoring integration

Source: Primary data processed (2024)

The candidate requirements were then analyzed to remove redundancy, group related needs, and break down general requirements into more specific system requirements, resulting in 10 system requirements that were subsequently prioritized using the MoSCoW method. Each requirement was assigned a Requirement ID (R01–R10) to support documentation, validation, and traceability, as presented in Table 6.

Table 6. System Requirement Priorities Based on the MoSCoW Method

ID	Requirement	Priority	Prioritization Benchmark
R01	Automatic Data Acquisition	Must	Real-time monitoring
R02	Real-Time Data Integration	Must	Operational data integration

ID	Requirement	Priority	Prioritization Benchmark
R03	Historical Database	Must	Historical analysis
R04	Alarm Correlation	Must	Disturbance analysis
R05	Dashboard Monitoring	Should	Monitoring visualization
R06	Multi-site Monitoring	Should	System development
R07	Analytics-ready Data	Must	Predictive monitoring
R08	Early Warning Notification	Should	Early disturbance detection
R09	Condition Monitoring Integration	Could	Condition-based maintenance
R10	Communication Integration	Must	System communication integration

Source: Requirements analysis results (2024)

Based on Table 6, the Requirements Analysis produced 10 system requirements consisting of 6 Must items (60%), 3 Should items (30%), and 1 Could item (10%). The Must category was assigned to requirements that directly address the core problems of the existing monitoring system data acquisition, data integration, historical analysis, alarm correlation, analytics readiness, and communication integration—while the Should category serves to enhance monitoring effectiveness through information visualization, multi-site monitoring, and early warning notification, and Condition Monitoring Integration was placed in the Could category as a further development once the system's core requirements have been met.

To ensure that each system requirement had a clear basis traceable to its source, a requirement traceability process was carried out using the RTM, mapping the relationship between each system requirement and the observation, interview, and operational document findings underlying it, as presented in Table 4.

Table 7. Requirement Traceability Matrix

Data Source	Common Findings	Unique Value	Requirements Supported
Observation	Shows that monitoring already uses DCS, SCADA, and a historian.	Identifies the actual system condition, data flow, and field monitoring integration limitations.	R01, R02, R05, R07, R10
Stakeholder Interview	All informants emphasized the importance of improving monitoring reliability.	Describes operational needs, constraints, and stakeholder expectations for an IoT-based monitoring system.	All Requirements (R01–R10)
SCADA	Provides operational data in real time.	Validates the need for automatic data acquisition, data integration, monitoring dashboard, and inter-system communication.	R01, R02, R03, R04, R05, R07, R10
Archive Table	Stores alarm and event history.	Supports historical analysis and identification of disturbance patterns.	R03, R04, R08

Data KIT	Provides plant performance and operational data.	Supports evaluation of operational trends and the need for analytics-ready data.	R03, R07
Oil Analysis	Describes equipment health condition.	Forms the basis for the Condition Monitoring Integration requirement to support condition-based maintenance.	R09

Source: Requirements traceability analysis (2024)

Based on Table 4, each data source made a distinct contribution to the formation of the system requirements: observation described the actual condition of the monitoring system, while interviews identified operational needs and user expectations; SCADA, the Archive Table, Data KIT, and Oil Analysis served as technical data sources validating the system requirements based on the plant's operating conditions. This traceability shows that each system requirement has a clear empirical basis and can be accounted for as the outcome of the RE process.

Discussion

The research results show that the main problem with the PLTMG's monitoring system lies not in the availability of monitoring devices, but in the lack of integration among operational data originating from multiple sources—a condition that has kept monitoring, equipment-condition analysis, and maintenance decision-making from being carried out in an integrated manner. Accordingly, the core system requirements produced through RE are focused on data integration as the foundation for developing the IoT-based predictive monitoring system.

Based on the RE results obtained, this study developed a conceptual architecture for the IoT-based predictive monitoring system, representing the relationship between the system requirements and the proposed solution design. In this architecture, data originating from SCADA, Data KIT, Oil Analysis, and operational documents are integrated through a data integration layer before being stored in a historical database; the data are then processed by an analytics engine to produce equipment-condition information presented through a monitoring dashboard and early warning feature. This conceptual architecture shows that every system requirement produced through the RE process is interconnected in forming the IoT-based predictive monitoring system, so that the identified requirements are not only documented but also have a clear direction for implementation.

These findings are consistent with prior research emphasizing that RE plays a role in producing documented and validated system requirements prior to the design stage, and support the view that requirement quality and traceability are essential foundations for consistent system development. Unlike previous studies that focused more heavily on IoT implementation and predictive maintenance themselves, this study places RE at the center of the research, producing artifacts in the form of system requirements, an SRS, an RTM, and a conceptual model that together form the foundation for designing the IoT-based predictive monitoring system.

Causal Loop Model of IoT-Based Predictive Monitoring System Requirements

Although the conceptual architecture illustrates the main structure and flow of the IoT-based predictive monitoring system, the cause-and-effect relationships among system

requirements are not yet explicitly visible. This study therefore developed a *Causal Loop Model* (CLM) to visualize the relationships among system requirements and their influence on monitoring effectiveness, equipment reliability, and power plant availability.

The CLM shows that *Data Integration* is the initial requirement that builds the IoT-based predictive monitoring system by increasing *Data Availability*. Integrated data availability supports improved *Monitoring Capability*, which in turn strengthens *Analytics Capability* and *Dashboard Effectiveness*, together forming *Predictive Monitoring Capability*. This capability enables equipment-condition monitoring to be carried out more quickly, comprehensively, and on a data-driven basis. *Predictive Monitoring Capability* then improves *Maintenance Decision Effectiveness*, which in turn raises *Equipment Reliability* and *Power Plant Availability*. This cause-and-effect relationship shows that operational data integration is the core requirement connecting every function of the IoT-based predictive monitoring system, so that all system requirements produced through the RE process mutually reinforce one another in improving maintenance effectiveness and power plant operational reliability.

CONCLUSION

This study analyzed the requirements for an IoT-based predictive monitoring system at a Gas Engine Power Plant (Pembangkit Listrik Tenaga Mesin Gas [PLTMG]) using a Requirements Engineering (RE) approach. Applying this approach resulted in six candidate requirements that were refined into ten system requirements; these were subsequently prioritized using the MoSCoW method, documented in a Software Requirements Specification (SRS), and validated using a Requirements Traceability Matrix (RTM). The results indicated that operational data integration was a key requirement for supporting improved data availability, monitoring and analytics capabilities, and the effectiveness of maintenance decision-making. The study's contribution lies in the application of RE to generate documented and validated system requirements as a foundation for developing an IoT-based predictive monitoring system for PLTMG facilities. The resulting artifacts—comprising the SRS, RTM, conceptual architecture, and Context Level Model (CLM)—provided a documented basis for system development and can serve as a reference for future research.

As this study was limited to the requirements analysis phase, it did not cover the implementation or performance evaluation of the proposed system. Therefore, future research should focus on developing a prototype based on the generated SRS, integrating the system directly with Supervisory Control and Data Acquisition (SCADA) systems and IoT devices, and evaluating system performance within the PLTMG operational environment. Additionally, the development of machine learning-based analytical models for equipment failure prediction could be explored as a direction for future research to enhance the capabilities of the predictive monitoring system.

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