Designing Project Management Information System (PMIS) Features Framework of Independent Solar Power Generation Systems Project: Maintenance Phase in Indonesia using Quality Function Deployment (QFD) Method in PT XYZ

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Abstract*—The increasing complexity of large-scale infrastructure projects necessitates the integration of project management with digital technologies to ensure transparency, performance monitoring, and stakeholder accountability. Independent Solar Power Generation System Project: Maintenance Phase in 65 Locations in Indonesia managed by PT XYZ, faces significant challenges in reporting consistency, coordination, and real-time tracking. The current condition of the project monitoring relies on fragmented, manual methods, resulting in data inaccuracies, delayed decision-making, and weak oversight during the maintenance phase. To address these issues, a tailored Project Management Information System (PMIS) features framework was designed using the Quality Function Deployment (QFD) method. This research begins with identifying critical user needs through stakeholder interviews and questionnaires, which are then translated into technical responses via the House of Quality (HoQ). The process will produce a prioritized list of system features, leading to the conceptualization of a low-fidelity prototype. In the end, the resulting PMIS framework will serve not only as a problem-driven solution but also as a digital transformation blueprint for project environments lacking existing digital infrastructure. The proposed PMIS is expected to greatly improve project performance monitoring, accountability, and data integration across all project sites during the maintenance phase by making sure that the system design matches real-world conditions and input from stakeholders that has been verified.

***Keywords*—Project Management, Project Management Information System (PMIS), Quality Function Deployment (QFD), Project Performance, Project Maintenance**

I. INTRODUCTION

Indonesia's renewable energy sector has been rapidly expanding as part of the national strategy to diversify energy sources and promote sustainable development. Projects such as the Independent Solar Power Generation Systems initiative have played a pivotal role in improving energy access across rural and underserved regions. However, despite the scale and strategic importance of such initiatives, the project management practices in the maintenance phase remain underdeveloped. PT XYZ, a state-owned enterprise responsible for this initiative, has been grappling with fragmented communication, manual data collection, and non-standardized reporting formats across its 65 project sites.

The project's Looker dashboard, which supported real-time monitoring, was only available during the construction phase and discontinued after 2024, leaving the ongoing maintenance phase (2024–2025) without digital oversight tools.

TABEL 1
Need Statements

KC Monitored	*Percentage of Error/Missing Data*
*KC G******	*4,69%*
*KC T*********	*17,39%*
*KC P***********	*13,25%*
*KC T***********	*50%*
*KC K******	*40,83%*
*KC M******	*39,34%*

A quantitative review in Table 1 revealed alarming inconsistencies in data submission from multiple sites. For example, error or missing data rates were reported as high as 50% in some locations (KC T**********), and others showed persistent problems: KC K***** with 40.83% and KC M***** with 39.34% missing or incorrect data. There are additional problem indicators included:

A. Only 40% of sites submitted progress reports on time, far below the >90% target.
B. 0% of locations used structured digital reporting.
C. 52% of locations used non-standardized templates.
D. 0% of submitted reports included user metadata (identity or timestamp).

These challenges have had a direct impact on decision-making, progress tracking, accountability, and the ability to implement timely corrective actions. Thus, this study aims to develop a stakeholder-centered PMIS framework using the Quality Function Deployment (QFD) methodology to close the digital gap in maintenance phase monitoring. Based on these challenges, there are three research questions formed, include:

Q1. What are the user needs for monitoring and control in PT XYZ's maintenance phase?

Q2. How can QFD be applied to convert these needs into actionable system features?

Q3. What conceptual prototype can best represent a user-focused, problem-driven PMIS?

II. THEORETICAL BASIS

This research draws upon foundational project management and systems engineering concepts to support the proposed methodology.

A. Project Management

Project management involves systematically applying specific knowledge, skills, methods, and tools to ensure a project achieves its intended goals in an efficient and effective manner. As outlined in the PMBOK Guide (6th Edition), the process is divided into five key stages: initiation, planning, execution, monitoring and controlling, and closing. The initiation phase focuses on formally starting the project, while the planning phase develops detailed strategies that cover essential aspects such as timelines, budget, quality, and risk. Execution is the stage where the project plan is implemented, and most resources are utilized. Monitoring and controlling involve tracking the project's performance and making necessary adjustments to stay aligned with objectives. Last, the closing phase ensures all activities are completed and the project is officially concluded. These stages are supported by ten knowledge areas, including integration, scope, cost, schedule, and stakeholder management, which help guide the project team in maintaining coordination, managing risks, and delivering outcomes that meet expectations.

B. Project Performance and Digitalization

In modern project management, project performance and digitalization are becoming more and more connected. In order for a project to be successful, it needs to do more than just finish tasks, but needs to keep delivering value. Performance is evaluated through measurable indicators such as schedule variance, cost variance, and earned value (Kerzner, 2017), but the PMBOK 7th Edition (PMI, 2021) emphasizes a broader view through eight interconnected domains including stakeholder, team, planning, project work, delivery, measurement, and uncertainty, reflecting a systems-thinking approach. Digitalization transforms this performance landscape by embedding digital technologies across all project processes, enhancing efficiency, transparency, collaboration, and real-time decision-making (PMI, 2021). It makes it possible for adaptive feedback loops and dynamic value delivery systems to keep projects on track in environments that change quickly. This project's digitalization is not just technological but conceptual, redefining how projects are envisioned, executed, and managed to better align with both internal capabilities and external demands.

C. Project Management Information System (PMIS)

A PMIS serves as a digital platform for collecting, organizing, and distributing project information. As defined by Kerzner (2017), it supports decision-making at operational, tactical, and strategic levels, with features ranging from document control to real-time analytics and KPI dashboards.

D. Quality Function Deployment (QFD)

QFD is a systematic design methodology used to convert customer (or stakeholder) needs into prioritized technical requirements through the House of Quality (HoQ). Akao (1990) notes that QFD improves cross-functional alignment, customer satisfaction, and traceability of design decisions. It is especially helpful in the early stages of planning a digital product when there are many different stakeholder needs that need to be turned into a single system specification.

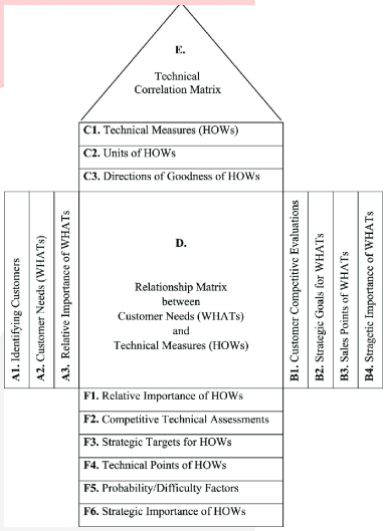

FIGURE 1
House of Quality (HoQ)

QFD improves cross-functional alignment, customer satisfaction, and traceability of design decisions. It is particularly useful in early-stage digital product planning where stakeholder needs are diverse and must be resolved into a unified system specification.

III. METHODOLOGY

This research conducts a qualitative and quantitative approach rooted in the QFD methodology. The method is divided into the following key steps:

Step 1: Open-Ended Questionnaires and Stakeholder Interviews

Initial data collection was conducted through open-ended questionnaires and semi-structured interviews with technicians, project coordinators, and staff involved in the maintenance phase. These sessions aimed to uncover latent needs, expectations, and challenges experienced in the current manual monitoring process.

Step 2: Need Statement Formulation

Based on insights from the open-ended responses, formalized need statements were constructed to represent specific, actionable stakeholder requirements.

Step 3: Development of the QFD House of Quality Matrix

The QFD Level 1 matrix (House of Quality) was developed to translate the stakeholder-driven need statements (WHATs)

into technical responses (HOWs). Relationship scores (9, 3, 1) were assigned to assess the degree of correlation between each WHAT and HOW. Additional ratings were applied to assess technical difficulty, implementation complexity, and the criticality of features

Step 4: Technical Prioritization and Feature Ranking

The QFD matrix results were synthesized to produce a prioritized list of PMIS features. The scores reflected weighted relationships between needs and technical responses, allowing researchers to focus on features offering the highest stakeholder value with feasible implementation.

IV. RESULTS AND DISCUSSION

The research utilized the Quality Function Deployment (QFD) method to translate qualitative stakeholder feedback into a structured, prioritized set of technical responses for a Project Management Information System (PMIS) in the Independent Solar Power Generation System Project (Maintenance Phase) at PT XYZ. The process followed six sequential steps:

Step 1: Open-Ended Questionnaires

Primary data were gathered from 65 project locations using open-ended questionnaires directed at field technicians, coordinators, and project managers. Responses revealed recurring issues: (1) connectivity problems, (2) fragmented documentation, and (3) absence of real-time alerts. These formed the thematic basis for system requirement formulation.

Step 2: *Need Statement Formulation*

From the qualitative input, 21 user need statements (V1–V21) were synthesized as shown on Table 2. These needs became the "WHATs" in the QFD matrix.

TABEL 2
Need Statements

No	Need Statements
V1	The PMIS allows asynchronous data entry to accommodate delayed or after-hours reporting.
V2	The PMIS includes data verification tools (e.g., timestamps, geo-tags, photos) to ensure report authenticity.
V3	The PMIS has a simple and intuitive interface for maintenance personnel.
V4	The PMIS supports easy real-time or delayed data input with minimal training required.
V5	The PMIS reduces the reporting burden by streamlining input processes.
V6	The PMIS enforces standardized templates for reporting project issues.
V7	The PMIS supports audit verification processes for both internal and external reviews.
V8	The PMIS integrates project-related documents (e.g., contracts, reports, site photos) into a single centralized platform.
V9	The PMIS sends automated alerts to stakeholders when delays, disruptions, or site issues occur.
V10	The PMIS allows field supervisors to access and review plans and records in remote areas.
V11	The PMIS allows exporting reports in various formats (e.g., PDF, Excel) for internal and external use.
V12	The PMIS provides detailed information of the current situation.
V13	The PMIS supports user profile and role-based access levels.
V14	The PMIS allows only authorized personnel to make changes, while restricting others to view or comment access.
V15	The PMIS provides a visual tracker like status table per location.
V16	The PMIS supports flexible metrics tailored to different project stages or needs.
V17	The PMIS integrate with communication platforms (e.g., email, internal communication)
V18	The PMIS supports instant messaging or notification features to coordinate tasks and reduce delay.
V19	The PMIS includes a feedback module for users to rate the system and report issues.
V20	The PMIS displays performance using intuitive visual indicators (e.g., red = issues, green = working).
V21	The PMIS allows users to assess status and performance at a glance.

Step 3: Development of the QFD House of Quality Matrix

To determine which stakeholder needs should be prioritized in the system design, the Weighted Average Performance (WAP) method was applied. Each stakeholder's need was assessed based on two criteria: how important the need is to the user, and how satisfied they currently are with how the need is being addressed. The WAP score is a reflection of both the importance of a need and the size of the performance gap between user expectations and the current system condition.

TABEL 3
Weighted Average Performance

Need Statement	Importance	Satisfaction
V1	3,29	3,16
V2	3,35	3,68
V3	2,13	3,48
V4	3,29	2,32
V5	2,45	3,00
V6	2,87	3,06
V7	2,16	3,48
V8	1,65	3,39
V9	2,10	2,65
V10	2,48	2,23
V11	2,52	3,32
V12	2,23	3,45

V13	2,52	3,45
V14	1,68	2,13
V15	2,16	2,23
V16	2,42	2,81
V17	2,84	3,52
V18	2,32	3,65
V19	2,19	3,39
V20	2,19	3,26
V21	2,45	3,35

The needs with the highest WAP scores represent the most urgent areas for improvement, as they combine high stakeholder importance with low current satisfaction. These WAP scores were then normalized to determine the relative weight of each need in the QFD analysis.

Following the formulation of 21 stakeholder-driven need statements (WHATs) and 28 corresponding technical responses (HOWs), the Quality Function Deployment (QFD) Level 1 matrix, also known as the House of Quality, was constructed to systematically map relationships between user expectations and system features. Each intersection between a WHAT and a HOW was evaluated using a standard QFD scoring system, which is 9 for a strong relationship, 3 for a moderate, and 1 for a weak as the results, as shown in Table 4. These values were assigned through expert judgment and functional analysis to reflect the relative impact of each technical response in addressing specific needs. Figure 2 shows the Relationship Matrix of the HoQ.

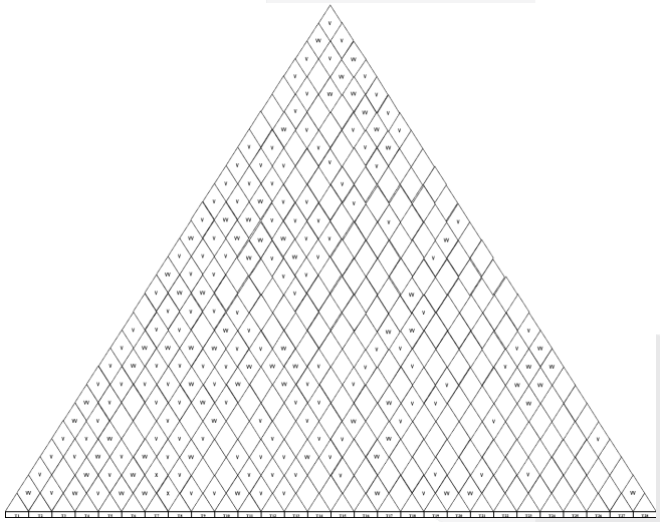

FIGURE 2
Relationship Matrix

Step 4: Technical Prioritization and Feature Ranking

After calculating the relationship scores and applying importance weights derived from the Klein Grid Matrix (KGM), the QFD matrix output was synthesized to prioritize the PMIS technical features. The prioritization was based on Contribution Value, which is the product of each need's normalized importance weight and the strength of its relationship with a given technical response. These values were aggregated for each feature across all stakeholder needs to yield a total contribution score. The ranking process provided a data-driven basis for identifying the most valuable system components. The features with the highest contribution values were deemed to provide the greatest stakeholder impact per development effort, taking into account not only what users needed but also how realistically those needs could be fulfilled. This prioritization is crucial in environments like PT XYZ's, where resource constraints and deployment challenges limit the scope of immediate implementation. Table 4 shows the overall results of the QFD.

TABEL 4
Ranked Features and Weight

Rank	TF	Description	Raw Weight	Normalized Weight
1	T9	Log and Registers (Audit Log, Change Log, Issue Log, Risk Register)	1.20	0.06
2	T27	Summary Widgets on Home Dashboard (S-Curve, Project Information)	1.14	0.06
3	T11	Linked Document Viewer (e.g., contracts, photos)	1.07	0.05
4	T24	Notification Center for Updates	0.98	0.05
5	T10	File Repository (Maintenance Report, Project Files, Project Charter, etc.)	0.88	0.04
6	T5	Predefined Report Templates	0.84	0.04
7	T28	Status Recap with Filter Options	0.83	0.04
8	T16	User Account Roles (Project Manager, Technician, Staff)	0.80	0.04
9	T6	One-click Submission	0.79	0.04
10	T22	Email and MS Teams Integration	0.78	0.04
11	T2	Photo Proof Tools (Include GPS & Timestamp)	0.77	0.04

12	T23	Built-in Chat between Team Members	0.76	0.04
13	T15	Status-by-site Overview Panel	0.76	0.04
14	T26	Performance Heat Map	0.75	0.04
15	T19	Interactive Status Indicators	0.74	0.04
16	T3	Quick Access Dashboard	0.74	0.04
17	T17	Comment-only or View-only Mode (Based on User Account Type)	0.74	0.04
18	T20	Visual KPI (SPI, CPI, etc.)	0.69	0.03
19	T1	Offline Data Input Module	0.68	0.03
20	T14	Export to PDF, Excel, and CSV	0.65	0.03
21	T7	Integrated Report Menu	0.63	0.03
22	T4	Icon-based Navigation	0.55	0.03
23	T25	In-system Feedback Form	0.52	0.03
24	T12	Delay Escalation Tracker	0.52	0.03
25	T8	Lockable Templates with Dropdown Selections	0.43	0.02
26	T13	Mobile App Access to Plans	0.37	0.02
27	T21	Calendar, Schedule Baseline	0.12	0.01
28	T18	Location-filtered Site Map	0.08	0.00

Table 4 presents the normalized weight rankings of all 28 technical responses, highlighting the top ten features prioritized for initial development. The Log and Registers (T9) emerged as the highest priority due to its critical role in ensuring traceability and data authenticity. This was followed by the Summary Dashboard Widgets (T27) and Linked Document Viewer (T11), which address stakeholder needs for visibility and centralized access. These top ten features (with normalized weights ≥ 0.04) form a high-value cluster essential for enhancing verification, reporting, and coordination in the project maintenance phase.

Lower-ranked features, such as Location-Filtered Site Map (T18) and Calendar, Schedule Baseline (T21), were deprioritized due to their limited impact and can be reserved for later development stages. Additionally, the roof matrix identified feature conflicts, particularly between T6 (One-Click Submission), T7 (Integrated Report Menu), and T8 (Lockable Templates). These negative correlations were factored into the prioritization results, lowering the rank of T7 and T8 due to usability contradictions. T6 remained a priority due to its strong alignment with remote data input needs, despite its trade-off with standardization.

In addition, a feasibility analysis was carried out to compare various system formats and determine which platform best aligns with the stakeholder requirements identified in this research. First, commercial PMIS platforms tend to offer a broad range of advanced features, they are often costly and overly complex for use in current field conditions. Other than that, simpler tools like Google Looker Studio offer greater ease of use but lack critical capabilities such as audit tracking and document management. Given these constraints, a custom-developed web-based PMIS is considered the most appropriate solution, as it can be designed to directly address operational constraints while remaining affordable, scalable, and user-friendly.

V. CONCLUSIONS

This research was conducted to resolve the monitoring challenges during the maintenance phase of the Independent Solar Power Generation System Project at PT XYZ. As the lack of a centralized system was identified due to the fragmented documentation, delayed reporting, and poor coordination in the project, a Project Management Information System (PMIS) features framework was proposed to be developed using the Quality Function Deployment (QFD) method to address those challenges. The research followed a structured process: (1) identification of 21 stakeholder need statements through open-ended questionnaires and field observations involving technicians and coordinators; (2) translation of these needs into 28 technical features using a QFD relationship matrix to assess strength and relevance; and (3) prioritization of features using the House of Quality and Klein Grid Matrix, which highlighted critical areas such as offline data entry, centralized document access, visual dashboards, and messaging integration.

The selected features were structured into role-specific modules and translated into a low-fidelity prototype interface, developed with attention to UI/UX principles such as cognitive simplicity and clear affordance. The interface design followed a visual hierarchy: (1) core features were placed in high-visibility areas such as top-left and center screen zones, (2) mid-priority functions like file management and alerts were placed in sidebars, and (3) lower-priority or admin-only features were embedded in secondary views. The system also incorporated role-based access controls, ensuring each user type, Admin, Technician, Staff, and Project Manager, accessed only the necessary functions. While the prototype remains non-interactive and lacks mobile optimization, it offers a validated framework that bridges stakeholder needs with system design logic. In conclusion, the study achieves its goals by delivering a structured, stakeholder-driven PMIS design, offering a practical and scalable solution for improving project monitoring and coordination in infrastructure projects.

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