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Crowdsourced Facility Issues Reporting System: A Case Study in Higher Education Institution

Athiyatul Ulya[1*], Annisa Karima[2], Liza Afra[3], Annisya Febriana Lubis[4], M. Arsaly Athaaf Neutron[5]
[1,2,4,5]Faculty of Engineering, Department of Electrical Engineering, Information Systems, Malikussaleh University
[3]Faculty of Engineering, Department of Civic Engineering, Civic Engineering, Malikussaleh University, Indonesia
[1*]athiyatululya@unimal.ac.id

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***Corresponding Author**

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ABSTRACT

Higher education institutions (HEIs) face persistent inefficiencies in facility management due to reliance on manual, paper-based reporting mechanisms, resulting in communication bottlenecks, delayed maintenance, and a lack of traceability. Although crowdsourcing has proven effective in urban civic management, its application within the micro-environment of a university campus remains underexplored. This study aims to design, develop, and evaluate a web-based Crowdsourced Facility Issues Reporting System tailored for HEIs, utilizing a case study at the Faculty of Engineering, Malikussaleh University. Employing a Research and Development (R&D) approach, the system was developed iteratively using the Prototyping method, with requirements derived from interviews and observations analyzed via thematic analysis. The system was implemented using PHP and MySQL, featuring a three-tier role-based access control architecture (Reporter, Faculty Admin, and Bureau Admin). Functional evaluation through Black Box Testing confirmed that all system modules operated according to specifications. A key finding from the implementation is the efficacy of a "Tiered Triage" workflow model, where the Faculty Admin acts as an intermediary verification node. This hierarchical filtration successfully filters invalid or hyper-local issues before they reach the central bureau, preventing administrative overload. Ultimately, the system transforms passive facility users into active stakeholders by providing real-time status tracking, thereby restoring transparency, reducing manual data entry errors, and offering a scalable digital model for facility management in complex institutional bureaucracies.

INTRODUCTION

Higher education institutions (HEIs) represent complex micro-urban environments that require continuous maintenance of academic buildings, laboratories, dormitories, and communal spaces. The condition of campus facilities is closely associated with students' learning comfort and satisfaction (Alfitriya, et al., 2025). Qualitative evidence from an Indonesian university shows that students regard stable internet access, laboratories, comfortable classrooms, and well-maintained facilities as important for their learning, and that unreliable facilities and weak maintenance are recurring complaints (Pamuji, et al., 2026). Even so, many institutions still rely on reactive and manual maintenance practices (Gordian, 2025), and practitioner sources describe maintenance requests being handled through spreadsheets, email, and phone calls (Urbest, 2026). Recent campus studies report the same pattern: documentation and forwarding of facility complaints remain difficult without a dedicated reporting system (Fadilla & Sufaidah, 2026; Germino, et al., 2025).

In recent years, crowdsourcing has emerged as a participatory approach to urban management. A systematic review of data-gathering urban crowdsourcing platforms found that urban reporting is among the most common purposes, and that such platforms are consistently linked to a local government or administrative body that acts on the reports (Fornaroli & Gatica-Perez, 2023). Likewise, a review of smart city applications shows that most studies treat citizens as agents who report issues such as infrastructure maintenance problems (Bastos, et al., 2022). However, the platforms covered by these reviews operate at the city level, and the same review notes a strong geographic imbalance toward Europe and North America, with only two platforms identified in Asia (Fornaroli & Gatica-Perez, 2023). Crowdsourced reporting within the micro-environment of a university campus therefore remains underexplored.

The core problem addressed in this study is the persistent inefficiency of traditional facility reporting mechanisms in HEIs, which leads to unresolved maintenance issues, resource wastage, and user frustration. When students or faculty members encounter a facility issue such as a malfunctioning projector, a leaking pipe, or a broken air conditioning unit, the absence of a streamlined, mobile-accessible reporting channel often discourages them from reporting it. Furthermore, facility managers struggle to prioritize maintenance tasks due to a lack of centralized, and real-time data. There is a critical need to bridge the communication gap between the campus community and facility

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management through a modern, participatory framework.

Therefore, the primary purpose of this research is to design, develop, and evaluate a Crowdsourced Facility Issues Reporting System tailored specifically for a higher education institution, in this case, Malikussaleh University. By transforming passive facility users into active contributors, this study explores the viability of crowdsourcing as a tool for campus facility management. Through a case study approach at Faculty of Engineering, Malikussaleh University, this paper aims to provide empirical evidence on the practical benefits and challenges of implementing a crowdsourced facility management system, thereby offering a scalable model for other educational institutions.

LITERATURE REVIEW

This section reviews the current knowledge underlying the development of a crowdsourced facility issues reporting system in higher education. The review synthesizes recent advancements across four thematic subsections to identify the theoretical foundation and research gaps.

Facility Management in Higher Education Institutions

Facility management (FM) in higher education institutions (HEIs) is a complex discipline due to the heterogeneous nature of campus buildings and the diverse needs of stakeholders (Gordian, 2025). Unlike commercial real estate, HEI facilities operate as micro-urban environments where the physical environment directly correlates with academic performance, student well-being, and institutional reputation. Traditional FM in these institutions has historically relied on reactive maintenance, addressing problems only after they are reported through various, disconnected communication channels (Awasthi & Shukla, 2024; Suranta & Setyaningsih, 2026).

In 2025, the "State of Facilities in Higher Education" report showed that although spending on existing buildings increased by over 26% compared to the previous year, rising inflation has caused stewardship costs to rise sharply, leading to a continued shortfall in funding. This financial pressure requires more efficient and data-based facility management methods. Moreover, current trends indicate that higher education institutions are increasingly using digital solutions, such as IoT sensors, AI tools, and digital twins, to improve operational efficiency and promote sustainability. Even with these improvements, numerous higher education institutions continue to depend on reactive and manual maintenance methods, which result in delays, reduced efficiency, and potential safety hazards (Gordian, 2025).

Crowdsourcing in Urban and Public Infrastructure Management

The shift towards utilizing crowdsourcing in managing urban infrastructure, commonly referred to as "citizen reporting" or "participatory sensing," has become a significant focus in academic research. The theory is based on the idea of collective intelligence, which suggests that a group of people with different backgrounds and knowledge has a better understanding of local details than a small number of experts (Olszowski, et al., 2021). Crowdsourcing needs a clear person who starts the process, a group of people to involve, a defined task to complete, and a digital platform to use. Platforms such as FixMyStreet, a site reporting problems in the UK, have shown that using location-based crowdsourcing can speed up the process of identifying issues with city infrastructure. Furthermore, crowdsourcing enables greater public involvement by allowing citizens to function as widely spread sensors (Fornaroli & Gatica-Perez, 2023). However, the literature also reveals limitations. Key challenges identified in the literature include ensuring data accuracy from untrusted participants, maintaining privacy, and sustaining long-term engagement. Furthermore, the effectiveness of these systems is largely based on how motivated users are and how quickly the authorities respond; if users believe their reports are not being addressed, their involvement decreases significantly (Bastardo, et al., 2023).

Web-based Facility Issues Reporting Systems

The evolution of digital reporting in HEIs has increasingly shifted toward web-based platforms due to their universal accessibility and cross-platform compatibility. A web-based facility issues reporting system allows users to submit maintenance requests via a browser without the need for dedicated software, thereby lowering the barrier to entry. Web-based and mobile facility issue reporting systems are increasingly deployed in HEIs to streamline maintenance workflows and enhance user satisfaction. Recent implementations include systems that enable students, faculty, and staff to submit requests via web portals or mobile apps, with features such as issue categorization, photo uploads, severity tagging, and real-time tracking (Shesathri, et al., 2025).

In the context of higher education, recent studies have demonstrated the practical application of such systems. For instance, the University of Maryland launched "Facilities Service Central" in 2025, a web-based platform designed to make it easier to report facility-related issues and submit service requests (University of Maryland, 2025). Similarly, an Android-based "Building Maintenance and Management System" from 2025 enables students to report problems such as malfunctioning lamps or faulty water taps, and it is connected to a PHP server for administrative control (Shesathri, et al., 2025). At Holy Cross College, the implementation of a Digital Facility Reporting System (DFRS) through Google Forms enhanced the process of documenting and forwarding concerns to the appropriate personnel (Germino, et al., 2025).

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Academic research also suggests theoretical models for implementing mobile crowdsourcing in the context of facility maintenance. A 2022 dissertation introduced a mobile prototype that includes location-sharing capabilities and natural language processing to automatically classify issues and generate work orders (Bin Alhaj, 2022). Another study created a web-based information system to improve transparency of campus facilities, which included features for role-based access and managing maintenance records (Fadilla & Sufaidah, 2026). Even with these improvements, many systems are still isolated, lack local-based feedback mechanisms, or fail to integrate with broader facility management platforms. Moreover, challenges related to user adoption, including the creation of duplicate reports, limited user participation, and unclear methods of providing feedback, continue to exist.

Research Gap and Synthesis

The literature reveals several critical gaps that this study addresses. First, while crowdsourcing is well-explored in urban contexts, its application to campus-specific facility issue reporting remains underdeveloped. Second, existing web-based reporting systems in HEIs often lack crowdsourced validation mechanisms, leading to redundant or unverified reports. There is limited integration of occupant feedback with facility management decision-making, and few systems leverage geo-referenced, real-time data for proactive maintenance (Chung, et al., 2022). Third, while digital transformation trends emphasize AI, IoT, and digital twins, there is a disconnect between high-level digital strategies and ground-level reporting tools used by students and staff. Most implementations are top-down, with limited mechanisms for bottom-up, participatory input that could enhance system responsiveness and accountability. Finally, the literature lacks empirical case studies evaluating the effectiveness of crowdsourced facility reporting systems in HEIs, particularly in terms of user engagement, issue resolution rates, and impact on FM performance (Germino, et al., 2025). This study attempts to fills these gaps by designing, implementing, and evaluating a crowdsourced facility issues reporting system in a higher education institution.

METHOD

This study employs a Research and Development (R&D) approach with a case study conducted at a higher education institution, specifically Faculty of Engineering Malikussaleh University. The R&D approach was selected because the primary objective of this study is to produce a functional software product, in this case a Crowdsourced Facility Issues Reporting System, to address the inefficiencies of conventional facility reporting in academic environments (Baskerville, et al., 2026). To develop the system, the Prototyping method was adopted. Prototyping is a well-established software engineering approach that emphasizes iterative development, allowing developers and end-users to interact dynamically and refine requirements throughout the construction process (Yue & Feng, 2021). The stages taken in this study are divided into five sequential phases, commencing from the preparation stage and concluding with the reporting stage. The detailed breakdown of each stage is shown in Figure 1.

Preparation Stage

This initial stage focuses on establishing the foundational basis of the research. Three main activities are conducted here: (1) Formulating the research problem, specifically addressing the limitations of current manual facility reporting systems in higher education institutions; (2) Determining the research objectives, which aim to design and develop a crowdsourced reporting platform; and (3) Conducting a literature review concerning crowdsourcing concepts, facility management systems, and the prototyping methodology. The output of this stage is the formal Research Proposal, which guides the subsequent phases.

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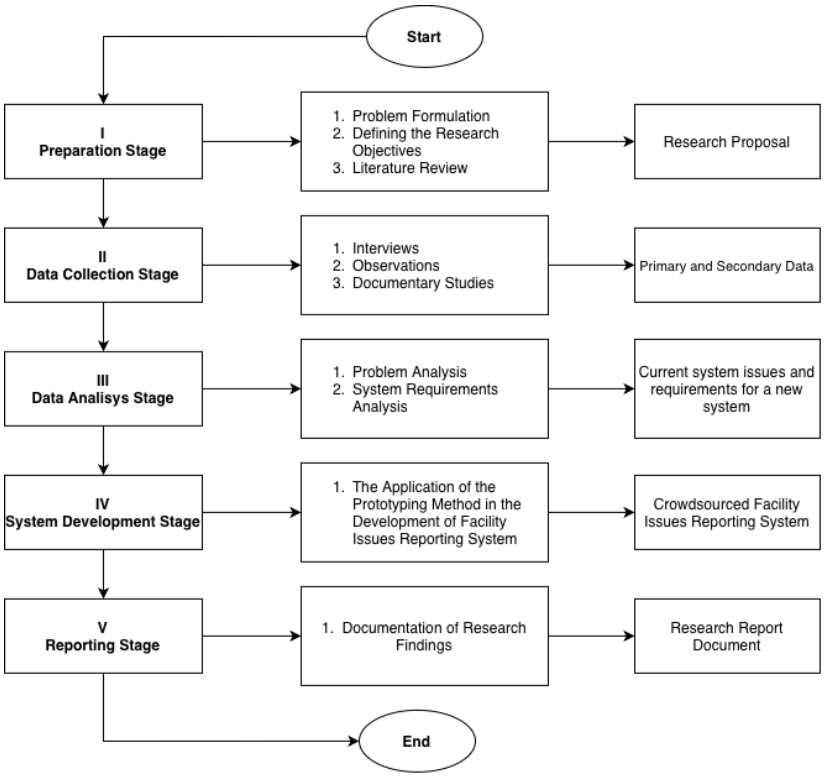


Figure 1. Research Stages

Data Collection Stage

To ensure the system accurately reflects actual user needs, data was gathered directly from the campus environment. The data collection methods utilized include: interviews; observation; and document study. Semi-structured interviews are conducted with key stakeholders directly involved in running the system to understand the current reporting workflow, bottlenecks, and user expectations. These include the Head of the General Affairs Division of the Faculty of Engineering at Malikussaleh University who is responsible for managing the facilities and infrastructure within the Faculty of Engineering environment. Furthermore, direct observation of the existing facility damage reporting procedures was conducted to identify inefficiencies and communication gaps between reporters and maintenance teams. Lastly, reviewing existing archival records, such as manual facility report logs and institutional asset databases was also conducted in this stage. The output of this stage is a robust set of Primary and Secondary Data ready for analysis.

Data Analysis Stage

The collected primary and secondary data are subsequently analyzed to form the conceptual foundation of the system. This stage is critical for translating raw user data into actionable system specifications. It comprises two main activities as in problem analysis and system requirement analysis. In order to systematically process the qualitative data gathered from interviews, observations, and document studies, this study employs Thematic Analysis. Thematic analysis is widely recognized for identifying, analyzing, and reporting patterns within data. This technique is highly suitable for this research as it allows the researcher to distill complex user complaints and operational bottlenecks into specific, categorized software requirements. Following the thematic analysis, the identified themes are translated into System Requirement Analysis. This involves defining the functional requirements (e.g., photo/evidence uploading and status tracking) and non-functional requirements (e.g., usability, scalability, and security) based on the extracted user needs and the crowdsourcing paradigm (Baskerville, et al., 2026).

System Development Stage

In this stage, the system is constructed using the Prototyping model. This method was specifically chosen for its flexibility in accommodating changing user requirements, which are often unclear at the beginning of a crowdsourcing project. The iterative cycle of prototyping applied in this research includes (Pressman & Maxim, 2020; Baskerville, et al., 2026):

- Requirements Gathering.
  In the first step, researchers establish general requirements with stakeholders based on the results of the analysis.

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- Quick Plan.
  This steps includes developing a rapid plan for the first iteration of the prototype.
- Modeling Quick Design.
  In this step, User Interface (UI) and User Experience (UX) designs are created at both low and high levels of detail.
- Development of Prototype.
  This is the stage at which a functional prototype of the crowdsourcing-based reporting system is rapidly developed.
- Deployment, Delivery, and Feedback.
  The last step includes deploying the prototype to selected users (students and staff), gathering feedback regarding its usability and features, and refining the prototype in the next iteration until the final system is achieved.

Reporting Stage

Following the system development stage, the next stage is reporting stage. The final stage of the research methodology serves as the culmination of the entire research and development lifecycle. This stage transcends mere administrative documentation; it involves the systematic synthesis of all technical artifacts, user feedback, and analytical findings into a comprehensive, formally structured academic document. The primary objective of this stage is to ensure that the knowledge acquired and the system developed are effectively communicated to academic peers, institutional stakeholders, and future researchers. The final output of this stage is a robust research report document and article that not only fulfils the academic requirements of the study but also provides a viable, ready-to-implement technological solution for the higher education institution.

RESULTS

This section presents the findings of the study in a logical sequence aligned with the research flow. It begins with the outcomes derived from the Thematic Analysis, followed by the architectural design results, the developed system functionalities categorized by actor roles, and finally results from the system testing and implementation phases.

Thematic Analysis and Requirement Elicitation

The application of thematic analysis to the interview transcripts, observation notes, and institutional documentation yielded several recurring themes regarding the current facility reporting workflow. The analysis process identified three primary themes: (1) communication bottlenecks, characterized by delayed or lost manual reports between faculties and the central bureau; (2) lack of traceability, where reporters had no mechanism to track the status of their submitted complaints; and (3) administrative inefficiency, related to the manual generation of official handover documents (official report / minutes of acceptance). These themes were directly translated into formal system requirements. The requirement analysis phase determined the necessity for a three-tier role-based access control mechanism to mirror the institutional hierarchy. The system must accommodate three distinct actors: the Reporter (Academic Community), the Faculty Admin, and the Bureau of General and Financial Affairs Admin.

System Designs

The system design phase focused on creating the architectural and visual blueprints for the Crowdsourced Facility Issue Reporting System. This phase translated the Software Requirements Specification (SRS) into technical models, beginning with a Use Case Diagram and followed by an Entity-Relationship Diagram (ERD). The process begins with the creation of a Use Case Diagram to map the interactions between the three primary actors (Reporter, Faculty Admin, Bureau Admin) and the system's core functionalities. A Use Case Diagram was produced, mapping approximately fourteen distinct use cases across the three primary actors. Figure 2 maps the interactions between the three actors and the system's core functionalities. The Reporter (academic community) logs in, submits reports with photographic evidence, views the history and status of submitted reports, and accesses a dashboard. The Faculty Admin views the list of incoming reports and verifies and forwards valid reports to the Bureau, and can print the official report. The Bureau Admin views forwarded reports, verifies them, assigns a technician, updates the report status, and prints the resolution report. The «include» relationship with the Login use case shows that all functionalities require authentication, while the «extend» relationships represent optional steps, such as forwarding a report after viewing the report list.

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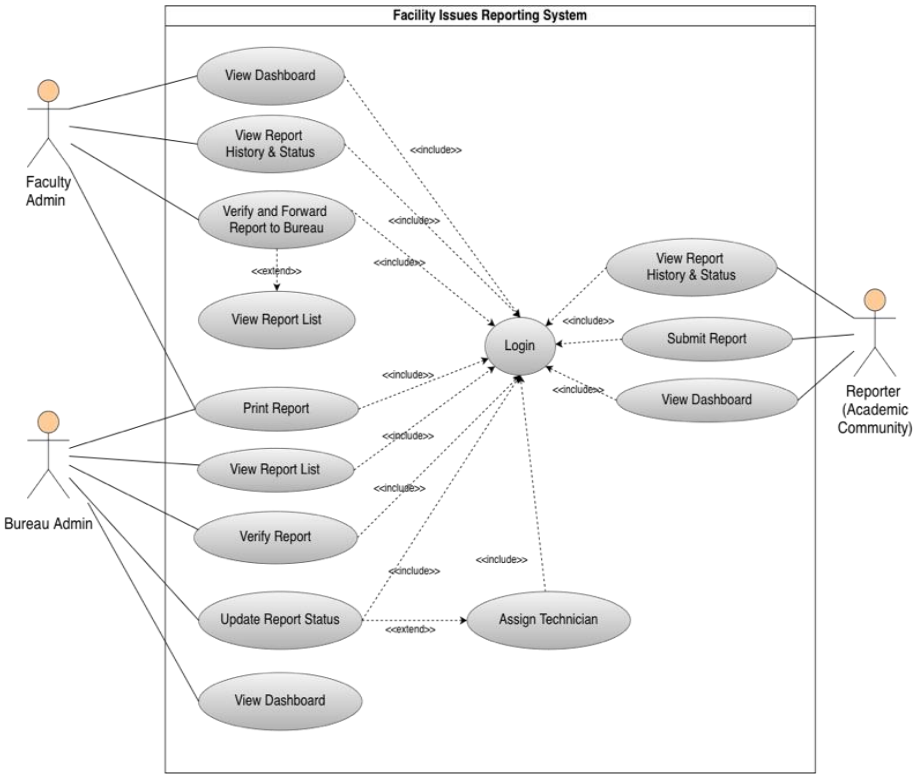


Figure 2. Use Case Diagram of the Crowdsourced Facility Issue Reporting System

Following this, Entity-Relationship Diagrams (ERD) are constructed to design the relational database schema, ensuring data integrity for user profiles, report logs, status histories, and technician assignments. The database design resulted in an Entity-Relationship Diagram (ERD) comprising seven primary relational tables. Key tables designed included: (1) Users Table: Storing credentials and role enumerators (Reporter, Faculty Admin, Bureau Admin); (2) Reports Table: Storing issue descriptions, timestamps, foreign keys linking to the reporting user, and current status enumerators; (3) Report_Status_History Table: A transactional table logging every status change with a timestamp to ensure full traceability; (4) Technicians Table: Storing maintenance personnel details and assignment statuses; (5) Report_Evidence Table: storing the report evidence (pictures); (6) Faculties Table; and (7) Categories Table.

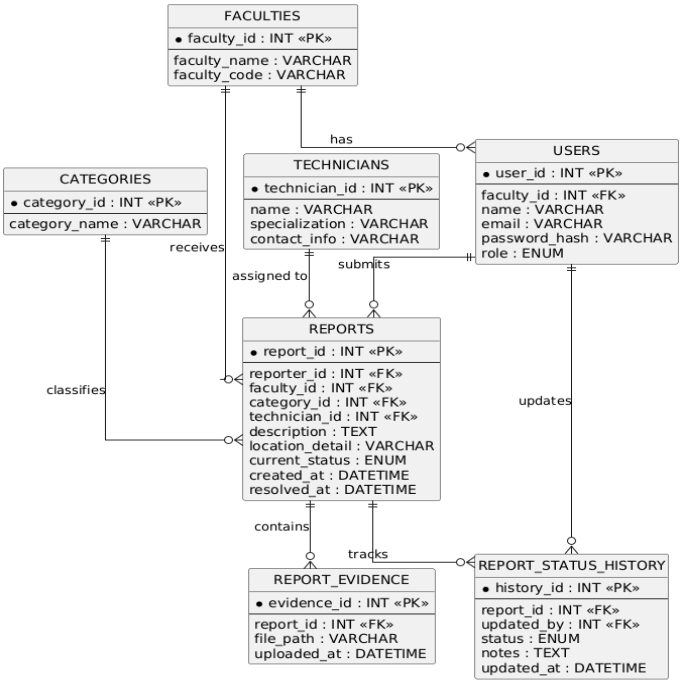


Figure 3. Entity-Relationship Diagram (ERD) of the Crowdsourced Facility Issue Reporting System

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Figure 3 presents the relational database schema that ensures data integrity and traceability. The Reports table is the central entity, linked to Users (the reporter), Faculties, Categories, and Technicians. Report_Evidence stores the uploaded files for each report, and Report_Status_History logs every status change with the responsible user and timestamp, so that the lifecycle of each report can be fully traced. The Users table stores credentials and the role attribute (Reporter, Faculty Admin, Bureau Admin) that underpins the role-based access control.

System Developments

The system is built as a web application, with PHP as the server-side programming language and MySQL as the database management system. This technology stack was chosen for its flexibility, rapid deployment capabilities, and proven efficacy in managing dynamic, data-driven institutional applications (Ardian, et al., 2026). This architecture facilitates centralized data storage and allows the system to be accessible from various locations via a web browser. The implementation is made up of multiple key interfaces, including the login page, dashboard, data administration page, and graphics-based report page. Each interface is intended to facilitate certain user tasks while ensuring fluid interactions between the end user and the system itself. The integration of the application layer and database helped guarantee all data operations are executed efficiently and securely.

Utilizing the prototype methods, a system was created to meet the requirements of three main users. Each party has unique functional features, which include :

- Submit a Report
  The form interface successfully accepts alphanumeric text for issue descriptions, provides a dropdown for facility categories (e.g., Electrical, Plumbing, Civil), and processes photographic evidence. The system successfully limits image uploads to a maximum of 10MB and accepts formats limited to .jpg, .jpeg, .png, and mp4. Upon submission, the system automatically generates a unique Report ID and sets the initial status to "Pending".
- View Report History and Status
  The tracking table queries the database for entries matching the logged-in user's ID. The interface displays real-time status labels namely Pending, Verified by Faculty, Forwarded to Bureau, Assigned to Technician, and Resolved.
- Verification and Forwarding
  The workflow mechanism allows the admin to review the submitted photographic evidence. Upon clicking "Verify & Forward," the system executes a database transaction that changes the report status from "Pending" to "Verified by Faculty," logs the timestamp in the Status_History table, and makes the report visible to the Bureau Admin.
- Verification & Assign Technician
  The system provides a secondary validation interface. Once verified, the "Assign Technician" module queries the Technicians table for available personnel. The admin can select a technician, triggering a status update to "Assigned."
- Update Status & Print Report
  The status update module allows the Bureau Admin to transition the report status to "Assigned to Technician" and finally "Resolved." This database update successfully cascaded to the Reporter's interface in real-time. The administrative document generator produced the final resolution record, including the assigned technician's name and resolution date.

System Evaluation and Testing

The system evaluation and testing step is designed to guarantee that all functions of the developed system work properly and meet user expectations. This evaluation and testing process determines whether each system feature generates the desired output based on the given input. Functional testing is an essential software validation method aimed at ensuring that each function of the software operates in compliance with the specified requirements (Ulya, et al., 2025). In this study, testing was carried out adopting the Black Box Testing method, which focuses on validating system functionality and input-output behavior without scrutinizing the internal code structure.

Table 1. Black Box Testing Results

Test Scenarios	Input Descripiton	Expected Output	Results	Status
TC-01: User Login (All Actors)	Enter a valid *Username* and *Password*, then click the "Login" button.	The system validates the credentials and redirects the user to the role-specific Dashboard (Reporter, Faculty Admin, or Bureau Admin).	The system successfully validated the credentials and redirected the user to their respective role-based Dashboard.	Pass
TC-02: Login	Enter a valid	The system displays an error	The system displayed an	Pass

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with Invalid Data	*Username* and an incorrect *Password*, then click "Login".	message and denies access to the system.	"Invalid username or password" error message and remained on the Login page.	
TC-03: Submit a New Report (Reporter)	Fill out the report form (issue description, category, location, upload photo evidence), then click "Submit".	The system saves the report data to the database, generates a unique Report ID, and sets the initial status to "Pending".	The report data was successfully saved, a unique Report ID was generated, and the status was automatically recorded as "Pending".	Pass
TC-04: Submit Incomplete Report Data (Reporter)	Fill out the report form but leave mandatory fields (e.g., description or photo) empty, then click "Submit".	The system displays a validation error stating that mandatory fields are missing and prevents the data from being saved.	The system rejected the submission and displayed a warning message to fill in the required fields.	Pass
TC-05: View Report History and Status (Reporter)	Click the "Report History" menu on the Reporter's Dashboard.	The system displays a table containing the user's previously submitted reports along with their real-time status (e.g., Pending, Verified, Resolved).	The system displayed the user's report history table, synchronized in real-time with the database.	Pass
TC-06: View Incoming Reports List (Faculty Admin)	Log in as Faculty Admin and navigate to the "Incoming Reports" page.	The system displays a list of new reports submitted by the academic community within that specific faculty with a "Pending" status.	The system displayed a tabular list of incoming reports filtered by the Faculty ID.	Pass
TC-07: Verify and Forward Report (Faculty Admin)	Select a "Pending" report, review the details, and click the "Verify & Forward to Bureau" button.	The report status changes to "Verified by Faculty", the data is sent to the Bureau Admin's queue, and the Report becomes printable.	The report status was updated to "Verified by Faculty" and immediately appeared on the Bureau Admin's Dashboard.	Pass
TC-08: Print Official Report (Faculty Admin)	Click the "Print Berita Acara" button on the detail page of a verified report.	The system generates a downloadable PDF document containing the report details and official administrative form.	The system successfully rendered the report data into a printable PDF document.	Pass
TC-09: Verify Report by Bureau (Bureau Admin)	Log in as Bureau Admin, select a report forwarded by the Faculty Admin, and click "Verify".	The report status is updated to "Verified by Bureau" and becomes ready for technician assignment.	The report status was successfully updated to "Verified by Bureau" in the database.	Pass
TC-10: Assign Technician (Bureau Admin)	Open a verified report detail, select a Technician's name from the dropdown menu, and click "Assign".	The report status changes to "Assigned", the technician's name is recorded in the report data, and the reporter can see the update.	The selected technician was successfully linked to the Report ID, and the status was updated to "Assigned".	Pass
TC-11: Update Report Status to Resolved (Bureau Admin)	Open an in-progress report, click "Update Status", and select "Resolved".	The report status changes to "Resolved" and the completion timestamp is automatically recorded in the system.	The report status was updated to "Resolved" with an accurate system timestamp.	Pass
TC-12: Print Resolution Official Report (Bureau Admin)	Click the "Print Berita Acara" button on a report with a "Resolved" status.	The system generates a final Report document that includes resolution details and the assigned technician's name.	The system successfully generated a final PDF Report document with complete resolution data.	Pass

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The results of the black-box testing show that all system features function properly and produce the expected output. The developed system is capable of accepting input data, processing it correctly, displaying accurate information, and responding appropriately to user actions. The test results also confirm that all system functions operate correctly and consistently. No critical errors were found during testing, indicating that the system is stable and reliable and is therefore considered ready for implementation.

DISCUSSION

The transition from manual, paper-based facility reporting to a digital Crowdsourced Facility Issues Reporting System presents a significant paradigm shift in how higher education institutions manage their physical infrastructure. The research trials conducted during the prototyping and implementation phases yielded functional outcomes that directly address the specific administrative and engineering problems identified in the earlier stages of this study.

A critical evaluation of the results reveals a stark contrast between the "measured" data from the legacy manual system and the "modeled" data from the newly developed digital system. In the measured manual workflow, observational data highlighted severe communication bottlenecks, where reports transferred between faculties and the central bureau experienced a lag of several days. Conversely, the modeled digital system demonstrated a marked improvement in operational efficiency. By automating the data capture process through the Reporter's submission form and standardizing the Official Report generation into a downloadable digital format, the system reduced document processing time to mere seconds. The findings suggest that this elimination of manual data entry not only mitigates administrative fatigue but also drastically reduces the probability of human error. The digital workflow ensures that data integrity is maintained from the moment a crowdsourced report is submitted until the final resolution is logged (Pampana, et al., 2024; Gräfe, et al., 2024).

The primary engineering problem addressed in this study is the lack of a unified, real-time data synchronization mechanism among institutional stakeholders. The legacy system acted as a "black box" where reports entered but disappeared from the reporter's purview. The implementation of the role-based access control mechanism and the centralized database directly solve this issue (Purba & Hidayasari, 2026).The findings suggest that the three-tier architecture (Reporter → Faculty Admin →Bureau Admin) creates a highly structured, transparent communication channel. The real-time status cascade where an action taken by the Bureau Admin instantly updates the Reporter's dashboard fosters a sense of accountability. The trial results indicated that reporters were highly receptive to the status tracking feature. Consequently, providing the academic community with the ability to monitor the lifecycle of their reports transforms them from passive complainants into active stakeholders in facility management, which is the core objective of a crowdsourcing approach (Bastardo, et al., 2023; Fornaroli & Gatica-Perez, 2023)

One of the most significant findings from the system implementation is the efficacy of the "Tiered Triage" workflow model. Initially, it might be assumed that all reports should go directly to the central Bureau of General and Financial Affairs for immediate action. However, the research trials demonstrated that routing all crowdsourced data directly to the Bureau creates an unmanageable administrative bottleneck. By engineering the Faculty Admin role as an intermediary triage node, the system effectively filters out invalid, duplicate, or hyper-local issues that do not require central intervention. This finding suggests that hierarchical filtration is a crucial design element for crowdsourcing systems in complex institutional bureaucracies, as it optimizes the workload of central technical execution teams (Wiggins, et al., 2011; Jacquin, et al., 2023).

While traditional crowdsourcing platforms often rely on the crowd itself to validate and prioritize issues, the institutional context of a university demands strict administrative accountability (Flanagin & Metzger, 2008; Veeckman & Temmerman, 2021). Consequently, this system redefines the crowdsourcing paradigm within a bureaucratic setting by replacing crowd-validation with a structured "Tiered Triage" model. In this approach, the "crowd" (the academic community) functions purely as a distributed sensor network, sourcing and submitting ground-level facility data. The validation and routing of this data, however, are shifted to designated administrative nodes (Faculty and Bureau Admins). This hybrid approach ensures the broad, democratic data collection inherent to crowdsourcing, while maintaining the data integrity, security, and hierarchical accountability required for institutional maintenance workflows (Veeckman & Temmerman, 2021) (Jacquin, et al., 2023).

CONCLUSION

This study successfully addresses the research question of how to eliminate communication bottlenecks and a lack of traceability in higher education facility reporting by developing a Crowdsourced Facility Issues Reporting System using the Prototyping method. The research trials demonstrate that digitizing the workflow into a three-tier, role-based system fundamentally resolves the administrative inefficiencies of legacy paper-based methods. A significant insight obtained from the results is the efficacy of a "Tiered Triage" workflow model. By engineering the Faculty Admin as an intermediary verification node, the system successfully filters out invalid or hyper-local issues before they reach the central Bureau of General and Financial Affairs, thereby preventing central technical teams from being overwhelmed by unverified crowdsourced data. Furthermore, the iterative nature of the prototyping method allowed for continuous refinement of the user interface and the seamless integration of the Official Report document

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generation, which drastically reduced manual administrative processing time and data entry errors.

The primary benefit of this research is the restoration of transparency and accountability in campus facility management. By providing the academic community with real-time status tracking, the system transforms reporters from passive complainants into active stakeholders, fulfilling the core objective of the crowdsourcing approach. For administrative staff, the automated generation of official reports and centralized dashboards significantly reduces cognitive load and manual workload. Practically, this system is highly applicable not only to other higher education institutions but also to any large-scale bureaucratic organization, such as municipal governments or hospital complexes, that manages decentralized facility maintenance workflows. The architectural model proves that structured digital filtration is essential for managing crowdsourced inputs within complex institutional hierarchies.

Despite the successful implementation, the study acknowledges several limitations that inform future research directions. The current system operates purely as a reactive platform, relying entirely on human observation to identify facility issues. Furthermore, it depends heavily on the intrinsic motivation of the academic community, which may wane over time without formal incentives. Additionally, the system evaluation was conducted over a relatively brief implementation period with a limited sample size, which may not fully capture the system's performance under peak-load conditions. Based on these findings, further study should focus on integrating a gamification module to incentivize sustained crowdsourced participation. Moreover, transitioning from a purely reactive model to a hybrid predictive model by integrating Internet of Things (IoT) sensors for critical infrastructure is highly recommended. Developing a native mobile application with push notifications and conducting a longitudinal study over a full academic year would also provide deeper insights into the system's long-term scalability, user retention, and its overall statistical impact on facility resolution times.

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