

Property Management and Tagging System for Merchant Marine Academy of Caraga Incorporated

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ABSTRACT

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Manual property management at the Merchant Marine Academy of Caraga, Inc. (MMACI) in Butuan City, Philippines, produced human error, data loss, and inaccurate inventory records under the Office of Property Management and General Services. This developmental study designed, developed, and evaluated a web-based Property Management and Tagging System intended to centralize, automate, and streamline institutional asset management and tagging. A developmental research design supported by the descriptive method was employed, guided by the

Kanban framework for iterative development; the system was built on Laravel, Filament, and MySQL in a client–server architecture supporting create-read-update-delete operations, quick response (QR) code generation and scanning, and asset monitoring. Nine purposively sampled MMACI personnel evaluated the system using a researcher-made questionnaire anchored on the International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) 25010 software quality model. The system obtained high weighted mean ratings across all four quality factors: functionality (4.42, highly functional), reliability (4.29, highly reliable), usability (4.58, highly usable), and efficiency (4.59, highly efficient), yielding an overall mean of 4.47, described as highly acceptable. The system replaced manual, paper-based tracking with centralized, automated records, improving data accuracy, monitoring speed, and accountability within the Property Management and General

Services Office. These results indicate that a modestly resourced maritime training institution can adopt open-source web frameworks to modernize property governance without large capital investment. The findings support the applicability of the ISO/IEC 25010 quality model in evaluating locally developed administrative systems in small Philippine higher-education institutions.

INTRODUCTION

Institutions worldwide increasingly depend on automated inventory and asset-tracking systems to reduce human error and strengthen accountability. In North America, a case analysis of Amazon's supply chain found that model-driven, capacity-constrained inventory optimization allowed the company to shift from a largely manual to an almost fully automated replenishment and fulfillment process across multiple fulfillment centers, substantially reducing stock-outs and excess inventory (Aghababaei, 2021). In West Africa, Agboola et al. (2022) developed and deployed a web-based inventory platform for a Nigerian small and medium enterprise and reported that automation reduced processing time and human error relative to the enterprise's prior manual ledger system. Complementing these system-level findings, a systematic review of inventory management concepts conducted in South Africa emphasized that structured, technology-supported inventory control—regardless of sector—improves stock accuracy, cost efficiency, and service levels compared with manual or ad hoc methods (Munyaka & Yadavalli, 2022). Taken together, this global evidence base shows that the shift from manual to digital inventory control is a cross-continental phenomenon that benefits organizations of varying sizes and resource levels.

Within the Association of Southeast Asian Nations (ASEAN), similar patterns are documented. A thesis examining e-commerce order fulfillment in Vietnam found that inventory management and last-mile delivery operations were most reliable when supported by structured digital tracking rather than informal, paper-based coordination, and that Vietnamese online retailers who lacked such systems experienced slower, less accurate order fulfillment (Dang, 2020). In Malaysia, Lim et al. (2025) developed a web-based inventory system for small businesses and reported overall user satisfaction rates above ninety percent, with respondents citing real-time visibility and reduced manual workload as the system's principal benefits. An Indonesian study likewise designed an information system to address the inefficiencies of manual, paper-based inventory tracking in a high school setting, finding that automation improved record accuracy and reduced the time required for stock verification (Frida, 2024). These ASEAN-based studies suggest that the region's small enterprises, schools, and training institutions face inventory challenges comparable to those documented globally, and that similarly scaled web-based solutions are both feasible and effective in this context.

At the local level, Philippine studies reinforce this pattern. Aguala et al. (2021) found that grocery stores in Butuan City that applied systematic inventory monitoring and control practices sustained stronger business performance and

reduced stock losses during the economic disruptions of the COVID-19 pandemic, compared with stores relying on informal tracking. In the education sector, Tapado and Delluza (2016) developed the Equipment Inventory Management System (EIMS) for Catanduanes State University to replace the university's manual, error-prone equipment ledger, reporting improved organization and traceability of institutional equipment records. More recently, an assessment of property management practices in the City Government of Calamba found that planning, acquisition, and utilization of public assets were implemented more robustly than maintenance and disposal, and recommended a structured action plan to strengthen cost-efficiency across all phases of the property life cycle (Dela Cruz, 2025). These Philippine studies confirm that manual property and inventory management remains a persistent institutional weakness, particularly in schools and government offices that have not yet adopted digital tracking tools.

Despite this accumulating global, regional, and local evidence that digital systems improve inventory and property management outcomes, few studies have examined property tagging and monitoring specifically within Philippine maritime training institutions, which combine conventional office property with specialized nautical training equipment subject to strict accountability requirements. The Merchant Marine Academy of Caraga, Inc. (MMACI) in Butuan City experienced the same manual-process weaknesses documented in the literature—human error, data loss, and inconsistent inventory records under its Office of Property Management and General Services—yet no locally developed, empirically evaluated system existed to address these weaknesses within the institution's specific operating context. This study addressed that gap by designing, developing, and evaluating a purpose-built, web-based Property Management and Tagging System for MMACI, contributing a context-specific case of software quality evaluation using the ISO/IEC 25010 model within a resource-constrained Philippine maritime academy.

OBJECTIVES

This study aimed to develop and evaluate a web-based Property Management and Tagging System for the Merchant Marine Academy of Caraga, Inc. Specifically, the system was evaluated by selected institutional personnel in terms of (1) functionality, (2) reliability, (3) usability, and (4) efficiency, using the International Organization for Standardization/International Electrotechnical Commission (ISO/IEC) 25010 software quality model.

METHODOLOGY

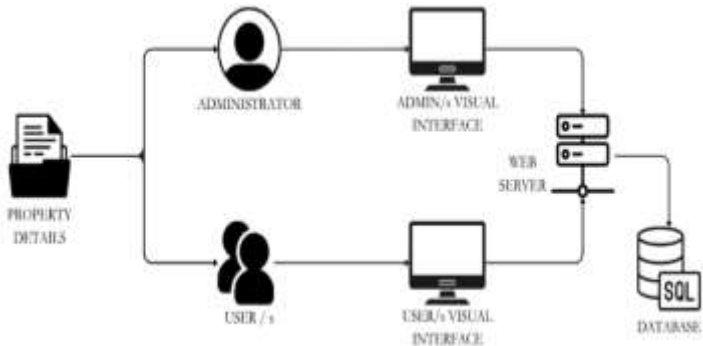
Research Design

This study used a developmental research design supplemented by the descriptive method. The developmental design was appropriate because the primary goal of the project was to design, develop, and implement a Property Management and Tagging System adapted to the needs of MMACI. The descriptive method was

applied to describe the institution's existing manual property management procedures and to summarize personnel evaluations of the completed system. The system was built following the Kanban approach to iterative software development, a pull-based Lean technique that visualizes tasks as they move through "To Do," "Doing," and "Done" states rather than through fixed sprint cycles.

Figure 1

System architecture of the Property Management and Tagging System



The system followed a three-layer client–server architecture consisting of a browser-based client (frontend) layer, a Laravel–Filament application (backend) layer, and a MySQL relational database layer. This architecture is consistent with the general client–server model described by Nyabuto (2024), in which a client requests a resource over a network and a server receives, processes, and responds to that request, allowing multiple users to access shared resources simultaneously. In the developed system, both regular users and administrators could view and enter property information through the browser interface, while administrators held additional privileges for administrative operations (Figure 1).

Figure 2

Data flow diagram (Level 0) of the property recording and reporting workflow

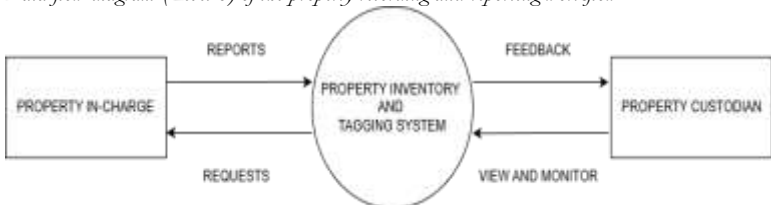
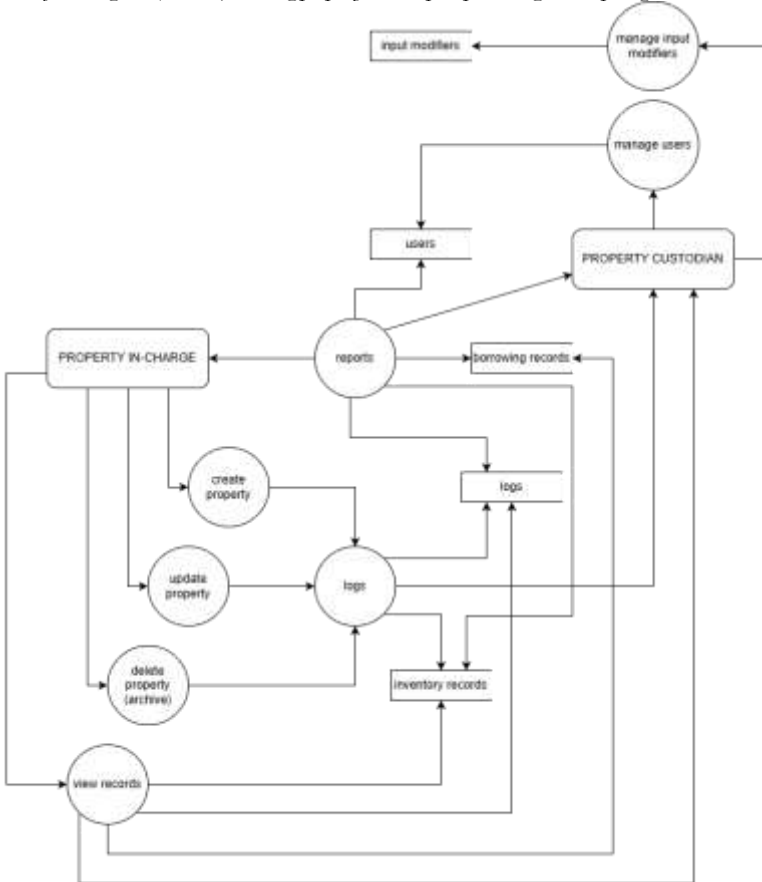
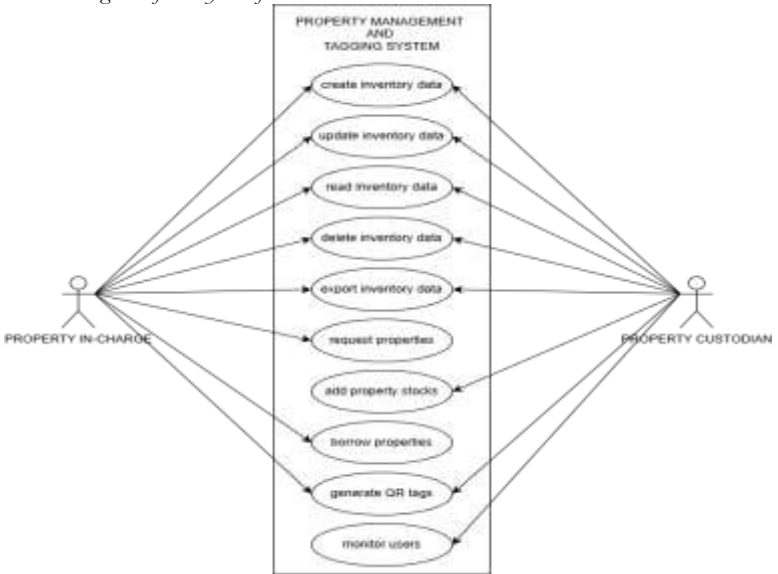


Figure 3

Data flow diagram (Level 1) showing property data input, processing, and report generation



The Level 0 data flow diagram (Figure 2) shows that a designated property-in-charge staff member records departmental properties, uploads the property list to the system, and the system forwards inventory reports to the Property Management and General Services Office. The Level 1 diagram (Figure 3) details how personnel input property data, the system processes this data, and the system subsequently generates reports for the Property Management and General Services Office to review and confirm.

Figure 4*Use case diagram of core system functionalities*

As shown in Figure 4, the system provided ten core functionalities: a) creating inventory data, b) editing inventory data, c) reading/viewing inventory data, d) deleting obsolete or erroneous records, e) exporting inventory data for audit or reporting purposes, f) requesting properties, g) adding property stocks, h) borrowing properties, i) monitoring inventory records, and j) generating and scanning quick response (QR) property tags.

Figure 5*Kanban board used to manage the iterative development workflow*

Figure 6*Gantt chart of the four-month system development timeline*

Development proceeded across four months (June to September), beginning with fourteen days of requirements gathering, followed by nine days of project planning, twenty-seven days of system design and module development, and fifteen days of testing and implementation (Figure 6). The fifteen-day testing period was divided into four sequential phases: functionality testing (four days), reliability testing (five days), usability testing (three days), and efficiency testing (three days), each targeting the corresponding ISO/IEC 25010 quality characteristic prior to deployment.

Research Site

The study was conducted at the Merchant Marine Academy of Caraga, Inc. (MMACI), a maritime training institution in Butuan City, Agusan del Norte, Philippines. MMACI served as the research site because the system was purpose-built to address property management weaknesses documented within its Office of Property Management and General Services.

Participants

Nine (9) respondents were purposively selected from among the heads of MMACI's various offices, together with personnel from the Office of Property Management and General Services and designated property-in-charge staff of each unit. Purposive sampling was used because not all institutional staff had direct interaction with the system; limiting participation to personnel who actively used or oversaw property records increased the validity of the evaluation.

Instrumentation

The evaluation instrument was a researcher-made questionnaire anchored on the ISO/IEC 25010 Systems and Software Quality Requirements and Evaluation (SQuaRE) model, which defines functionality (functional suitability), reliability, usability, and performance efficiency, among other characteristics, as measurable software quality attributes (International Organization for Standardization/International Electrotechnical Commission, 2011). The questionnaire used a five-point Likert scale, where five represented the highest level of agreement and one represented the lowest.

Research Ethics Protocol

Respondents' participation was solicited on a voluntary basis, and all questionnaire responses were collected and analyzed anonymously to protect respondent identity and encourage candid feedback. Because this study involved only human respondents evaluating an information system and did not involve floral, faunal, or indigenous-community data, gratuitous permits, indigenous peoples' free and prior informed consent, and animal-welfare protocols were not applicable.

Data Collection

A survey was administered to the nine purposively selected respondents to evaluate the developed system across the four ISO/IEC 25010 quality factors. Responses were collected once, following system deployment and the fifteen-day testing period described above.

Data Analysis

Table 1

Descriptive rating scale for the average weighted mean

Range of mean	Descriptive rating
4.21–5.00	Highly functional / highly usable / highly reliable / highly efficient
3.41–4.20	Functional / usable / reliable / efficient
2.61–3.40	Moderately functional / moderately usable / moderately reliable / moderately efficient
1.81–2.60	Less functional / less usable / less reliable / less efficient
1.00–1.80	Not functional / not usable / not reliable / not efficient

Responses were analyzed using the mean and the average weighted mean (AWM) to summarize personnel evaluations of the system's functionality, reliability, usability, and efficiency. Higher average ratings indicated stronger agreement with the system's performance, while lower ratings identified areas requiring improvement. Table 1 presents the descriptive rating scale used to interpret the computed means.

RESULTS AND DISCUSSION

Functionality of the system

Table 2

Functionality evaluation results

Indicator	5	4	3	2	1	Total	AWV
The software consistently delivers the expected results.	5	3	1	0	0	40	4.44
The software seamlessly integrates with other systems.	5	2	2	0	0	39	4.33

The software effectively supports data resumption and restoration.	5	3	1	0	0	40	4.44
The software successfully meets user reliability.	6	0	3	0	0	39	4.33
The software incorporates appropriately labelled buttons and commands.	6	2	1	0	0	41	4.56
Mean							4.42

The developed system obtained an overall mean score of 4.42 for functionality, described as highly functional. The highest-rated indicator was "the software incorporates appropriately labelled buttons and commands" (AWM = 4.56), while "the software seamlessly integrates with other systems" and "the software successfully meets user reliability" tied for the lowest AWM of 4.33, though both remained within the highly functional range. This finding echoes Agboola et al. (2022), whose web-based inventory platform for a Nigerian small enterprise likewise achieved strong functionality ratings once labelled controls and automated data entry replaced manual ledgers, suggesting that clear interface labelling is a consistent driver of perceived functionality across institutional settings. The comparatively lower rating for system integration indicates that while the MMACI system independently performs its core property-recording tasks well, it has not yet been tested for interoperability with other institutional information systems, an area meriting further development.

Reliability of the system

Table 3

Reliability evaluation results

Indicator	5	4	3	2	1	Total	AWV
The software implements robust security measures.	6	1	2	0	0	40	4.44
The software effectively handles errors.	6	3	0	0	0	42	4.67
The software fully complies with user requirements.	5	2	2	0	0	39	4.33
The software consistently exhibits prompt behavior.	4	3	2	0	0	32	3.56
The software fulfils all the required data for MMACI.	6	1	2	0	0	40	4.44
Mean							4.29

Reliability obtained an overall mean of 4.29, described as highly reliable. "The software effectively handles errors" received the highest AWM (4.67), while "the software consistently exhibits prompt behavior" received the lowest AWM (3.56), still within the reliable range. This pattern is consistent with the systematic review of Munyaka and Yadavalli (2022), which found that structured, technology-supported systems generally achieve strong error-handling and data-integrity outcomes but may still show variable response speed depending on server load and

network conditions—an observation directly applicable to the MMACI system's local-network MySQL deployment. The comparatively lower rating for promptness suggests that although the system reliably prevents data loss and manages errors, occasional delays were perceptible to some respondents, an area the institution may wish to monitor as usage scales.

Usability of the system

Table 4

Usability evaluation results

Indicator	5	4	3	2	1	Total	AWV
The software reliably performs assigned tasks.	6	3	0	0	0	42	4.67
The software features an attractive interface.	7	0	2	0	0	41	4.56
The software meets user usability requirements.	6	0	3	0	0	39	4.33
The software effectively modernizes property management.	8	1	0	0	0	44	4.89
The application runs smoothly with seamless processes.	5	3	1	0	0	40	4.44
Mean							4.58

Usability obtained the second-highest overall mean of 4.58, described as highly usable. "The software effectively modernizes property management" received the highest AWM (4.89), while "the software meets user usability requirements" received the lowest AWM (4.33). These results align with Lim et al. (2025), whose Malaysian small-business inventory system likewise received its strongest ratings on perceived modernization and ease of use, with over ninety percent of users reporting an intuitive interface. The consistently high usability ratings across indicators suggest that the interface design choices made during the Filament-based frontend development—dashboards, forms, and QR-based property lookup—translated into a genuinely accessible experience for non-technical institutional staff, supporting the system's readiness for wider institutional rollout.

Efficiency of the system

Table 5

Efficiency evaluation results

Indicator	5	4	3	2	1	Total	AWV
The software is user-friendly and easy to comprehend.	5	4	0	0	0	41	4.56
The software is easy to learn and navigate.	6	2	1	0	0	41	4.56
Users can easily utilize the system with minimal training.	6	2	1	0	0	41	4.56
The application enhances the efficiency of property management.	7	1	1	0	0	42	4.67
Mean							4.59

Efficiency obtained the highest overall mean of 4.59, described as highly efficient. "The application enhances the efficiency of property management" received the highest AWM (4.67), while three indicators concerning ease of comprehension, ease of navigation, and minimal training requirements tied at an AWM of 4.56. This finding parallels Dang (2020), who found that Vietnamese e-commerce operations relying on structured, low-friction digital tracking tools achieved faster and more accurate order fulfillment than those depending on informal coordination—reinforcing that ease of navigation and minimal training burden are recurring markers of efficient digital property or inventory tools across very different organizational contexts. For MMACI, the uniformly high efficiency ratings indicate that personnel could adopt the system with limited onboarding, an important consideration for an institution with constrained administrative staffing.

Overall system acceptability

Table 6

Summary of system evaluation results

Software quality factor	Mean	Descriptive rating
Functionality	4.42	Highly functional
Reliability	4.29	Highly reliable
Usability	4.58	Highly usable
Efficiency	4.59	Highly efficient
Overall mean	4.47	Highly acceptable

Across the four quality factors, the system obtained an overall mean of 4.47, described as highly acceptable. Efficiency obtained the highest factor mean (4.59), followed by usability (4.58), functionality (4.42), and reliability (4.29), which—although the lowest of the four—remained within the highly reliable range. This ordering suggests that MMACI personnel valued the system most for how quickly and easily it let them complete property-related tasks, while placing comparatively greater expectations on technical robustness such as system integration and response speed. The consistency of these results with prior developmental studies in Nigeria (Agboola et al., 2022), Malaysia (Lim et al., 2025), and Vietnam (Dang, 2020) indicates that the ISO/IEC 25010 quality model performs as a stable, cross-context evaluation framework for locally developed administrative software, extending its demonstrated applicability to the specific case of a Philippine maritime training institution. A methodological limitation of this evaluation is its reliance on a single-administration, purposive-sample survey of nine respondents; broader validation would require testing with a larger and more diverse user base, including field personnel who scan QR tags outside office settings, and repeated measurement over time to assess whether ratings hold as usage volume increases.

CONCLUSIONS

This study developed and evaluated a web-based Property Management and Tagging System that replaced the Merchant Marine Academy of Caraga, Inc.'s manual, paper-based inventory logs, which had been prone to human error, data loss, and inconsistent property records. Built on a Laravel–Filament–MySQL client–server architecture with quick response code tagging, the system was rated highly acceptable by institutional personnel, with an overall mean of 4.47 across the functionality, reliability, usability, and efficiency dimensions of the ISO/IEC 25010 software quality model. Beyond confirming that the developed artifact met its intended purpose, this study contributes new context-specific knowledge showing that the ISO/IEC 25010 quality model can be reliably applied to evaluate small-scale, in-house administrative software developed within a resource-constrained Philippine maritime training institution—a setting underrepresented in the existing inventory-management literature relative to commercial enterprises and large universities. The consistently high ratings across all four quality factors, mirroring patterns observed in comparable developmental studies from Nigeria, Malaysia, and Vietnam, support rather than negate the ISO/IEC 25010 model's cross-context validity, while also affirming that low-cost, open-source web frameworks can deliver measurably acceptable institutional software without large capital investment.

TRANSLATIONAL RESEARCH

The Property Management and Tagging System developed in this study is itself the translational output, addressing common property management challenges in academic institutions, with its accessible rollout to the wider academic community serving as the study's public-facing contribution. To extend the system's benefits beyond the initial evaluators, researchers will produce an illustrated user guide, quick-reference card, and short orientation video demonstrating QR tag scanning and report generation—directly supporting the finding that users required minimal training to operate the system.

Future refinements will extend this rollout through role-specific dashboards for monitoring department-level asset summaries and approvals, an optimized mobile interface (via progressive web app or frameworks like Flutter or React Native) for field personnel, and migration to cloud-based platforms enabling multi-campus access and real-time synchronization. A sustainability plan—regular updates, backups, and usability audits—will accompany full rollout to keep the system reliable for institutional transparency over time.

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