

Development and Validation of the Barangay Governance Information System (BAGIS) for Local Administrative Operations

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Abstract

This study developed and validated the Barangay Governance Information System (BAGIS) for selected local administrative operations in four barangays in the Municipality of Mainit, Surigao del Norte. A developmental research design guided by Design Science Research and Agile Software Development was employed. Data were gathered through needs assessment, questionnaires, semi-structured interviews, pilot observation, expert validation, and system logs. BAGIS was designed as a web-based modular platform for resident profiling, certificate issuance, water billing management, inventory management, dashboard monitoring, and report generation. Expert validation was conducted using selected ISO/IEC 25010:2023 software quality criteria, while user acceptability was assessed among 30 barangay personnel. The findings showed that the existing administrative processes were largely manual or semi-manual, resulting in repeated encoding, delayed transactions, inconsistent records, and difficulties in retrieval and reporting. The strongest identified system needs involved water billing automation, certificate issuance, resident profiling, record organization, and report generation. BAGIS obtained an overall expert validation mean of 4.60, interpreted as very high, with security and functionality receiving the highest ratings. User acceptability obtained an overall mean of 4.42, interpreted as high, with intention to continue use and perceived usefulness receiving the highest scores. Pilot observations confirmed the successful completion of all major system tasks, while system logs demonstrated actual use of the developed modules. However, recorded errors and downtime incidents indicated the need for continued improvement in usability, maintainability, login stability, error handling, template expansion, backup procedures, and user training. The study concluded that BAGIS is a functional, acceptable, and validated digital system that can support more organized records, faster transactions, improved monitoring, and efficient reporting in barangay administrative operations.

Keywords: Barangay Administration, Digital Governance, Information System, Local Government, Software Validation, User Acceptability

1. Introduction

Digital transformation has become a central direction in public administration as government institutions are increasingly expected to deliver services that are efficient, accessible, transparent, and responsive to citizens. Digital government involves more than converting paper records into electronic files; it requires the strategic use of technologies and data to redesign administrative processes, strengthen institutional capacity, and improve public service delivery (Mergel et al., 2019; Organisation for Economic Co-operation and Development [OECD], 2024). The United Nations Department of Economic and Social Affairs (UN DESA, 2024) similarly emphasized that

resilient digital infrastructure, integrated online services, and institutional readiness are essential to contemporary governance. The World Bank's GovTech framework further identifies core government systems, digital public services, citizen engagement, and enabling institutional conditions as major dimensions of public-sector digital transformation (World Bank, 2022, 2025). These developments indicate that digital information systems have become necessary mechanisms for managing government records, supporting evidence-based decisions, and improving frontline transactions.

In the Philippines, barangays constitute the basic political and administrative units of government and serve as the primary points of contact between citizens and public institutions. Under Republic Act No. 7160, or the Local Government Code of 1991, barangays are responsible for implementing community-level programs and performing administrative functions that include maintaining resident and household records, issuing certificates and clearances, monitoring local services, managing supplies and resources, and preparing reports. However, many barangay offices continue to depend on logbooks, printed forms, folders, spreadsheets, and disconnected computer files. Such practices may lead to duplicated or incomplete records, slow information retrieval, inconsistent reports, delayed transactions, weak monitoring, and difficulty tracing administrative activities. These limitations are particularly evident in resident profiling, certificate issuance, water billing management, inventory monitoring, and report preparation. Although the Philippine government has expanded digital local government services through initiatives such as the Electronic Local Government Unit system, which has been adopted by more than 900 local government units, much of this digitalization has been concentrated at the municipal and city levels (Department of the Interior and Local Government [DILG], 2025). Barangays therefore continue to require localized systems that address their specific operational conditions and routine administrative workflows.

The development of the Barangay Governance Information System (BAGIS) was justified by the need to replace fragmented and repetitive administrative procedures with an integrated digital platform. BAGIS was designed to centralize resident profiling, automate certificate issuance, organize water billing records, monitor inventory, present dashboard information, and generate administrative reports. The system was intended not merely to computerize existing records but to improve the organization, consistency, accessibility, and traceability of barangay transactions. Such an integrated platform may reduce repeated data encoding, shorten transaction processing time, strengthen record accuracy, and provide barangay personnel with more timely information for monitoring and decision-making. It also supports the broader principles of digital governance by extending technology-enabled public administration to the community level, where citizens most directly experience government services.

Despite the increasing number of studies on e-government and web-based information systems, several gaps remain. Existing local government research has largely focused on municipal or city-level e-government services, while barangay-level digital administration has received comparatively limited systematic attention. Recent barangay information system studies commonly address individual functions, such as resident information management, certificate processing, or service monitoring, but fewer studies develop a unified platform that integrates resident profiling, certificate issuance, water billing, inventory management, dashboards, and reporting. Many systems are also designed for a single locality and are evaluated primarily through general user satisfaction or basic functionality measures. Consequently, there remains limited evidence from studies that combine software product quality evaluation, user acceptability assessment, direct observation during pilot use, qualitative feedback, and actual system-use data. There is also insufficient research on systems developed for smaller or resource-constrained barangays whose infrastructure, personnel capability, and administrative practices may differ from those of larger local government units.

The present study addressed these gaps through the development and validation of BAGIS in four selected barangays in the Municipality of Mainit, Surigao del Norte. It applied a developmental and user-centered process that began with the assessment of existing administrative problems and functional requirements, followed by system design, prototype development, pilot testing, expert validation, user evaluation, and refinement. The system was evaluated using selected ISO/IEC 25010 software quality characteristics, including functionality,

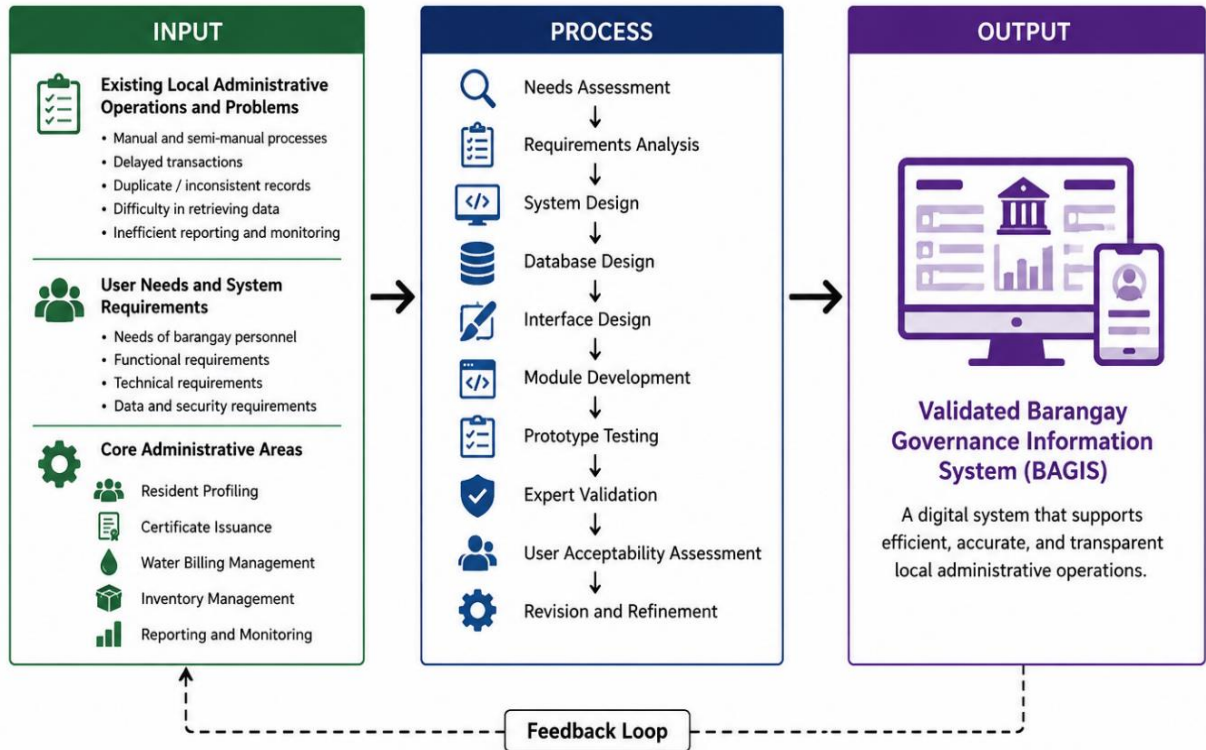


usability, reliability, efficiency, security, and maintainability, while user acceptability was assessed in relation to ease of use, usefulness, interface clarity, operational suitability, actual use, and satisfaction. Evidence from questionnaires, interviews, observations, and system logs was incorporated to provide a more comprehensive basis for validation. Through this approach, the study sought to produce a locally responsive and empirically validated information system that could improve selected barangay administrative operations and contribute to the continuing digital transformation of grassroots governance.

Theoretical Framework

This study was anchored primarily on Design Science Research, Agile Software Development, Digital Transformation in Public Administration, the ISO/IEC 25010 Software Product Quality Model, and the Unified Theory of Acceptance and Use of Technology. Design Science Research provided the principal foundation because the study focused on creating and evaluating BAGIS as a technological artifact intended to address identified organizational problems in barangay administration (Hevner et al., 2004; Peffers et al., 2007). Agile Software Development guided the iterative processes of requirements analysis, system design, prototype development, testing, user consultation, revision, and refinement, thereby allowing the system to respond to emerging operational needs and user feedback (Behrens et al., 2021; Rath et al., 2025). Digital Transformation in Public Administration explained the broader governance rationale for replacing fragmented manual procedures with integrated, data-supported, and user-centered public-sector processes (Mergel et al., 2019; OECD, 2024). The ISO/IEC 25010 framework provided the criteria for evaluating BAGIS in terms of functional suitability, usability, reliability, performance efficiency, security, and maintainability (International Organization for Standardization [ISO], 2023), while the Unified Theory of Acceptance and Use of Technology supported the assessment of user perceptions related to performance expectancy, effort expectancy, facilitating conditions, and behavioral intention (Venkatesh et al., 2003). Collectively, these frameworks established the conceptual and technical basis for the development, validation, user evaluation, and refinement of BAGIS as a digital platform for local administrative operations.





Source: Researcher's own conceptualization based on IPO Model, ISO/IEC 25010:2023, and UTAUT.

Figure 1. Diagram of Conceptual Framework

Figure 1 presents the conceptual framework of the study using the Input–Process–Output model. The input component includes the existing administrative problems, user needs, system requirements, and core barangay functions involving resident profiling, certificate issuance, water billing, inventory management, and reporting. These inputs undergo a systematic process of needs assessment, requirements analysis, system and database design, module development, prototype testing, expert validation, user acceptability assessment, and refinement. The output is the validated Barangay Governance Information System (BAGIS), which is intended to support more efficient, accurate, and transparent local administrative operations. The feedback loop indicates that evaluation findings and user experiences may be used to continuously improve the system.

Aim of the Study

This study aimed to develop and validate the Barangay Governance Information System (BAGIS) for the local administrative operations of selected barangays in the Municipality of Mainit, Surigao del Norte.

Statement of the Problem

Specifically, the study sought to answer the following questions:

1. What existing local administrative processes and problems served as bases for the development of BAGIS in terms of:
 - 1.1 resident profiling;
 - 1.2 certificate issuance;
 - 1.3 water billing management;

- 1.4 inventory management; and
- 1.5 reporting and monitoring?
 - 2. What functional and technical requirements were identified for the development of BAGIS?
 - 3. How was BAGIS designed and developed in terms of:
 - 3.1 system architecture;
 - 3.2 database structure;
 - 3.3 user interface;
 - 3.4 system modules;
 - 3.5 user access and security; and
 - 3.6 dashboard and reporting features?
 - 4. What is the level of expert validation of BAGIS in terms of:
 - 4.1 functionality;
 - 4.2 usability;
 - 4.3 reliability;
 - 4.4 efficiency;
 - 4.5 security; and
 - 4.6 maintainability?
 - 5. What is the level of user acceptability of BAGIS in terms of:
 - 5.1 ease of use;
 - 5.2 usefulness;
 - 5.3 clarity of interface;
 - 5.4 suitability to barangay operations;
 - 5.5 actual use; and
 - 5.6 overall satisfaction?
 - 6. What system improvements were recommended by the validators and intended users?
 - 7. What final version of BAGIS was produced after validation and refinement?

2. Review of Related Literature

Digital Governance and Public-Sector Transformation

Digital governance has moved beyond the simple computerization of government records toward the strategic redesign of public services, administrative processes, and institutional decision-making. Mergel et al. (2019) described public-sector digital transformation as an organizational change involving technologies, processes, structures, and service relationships rather than the isolated adoption of information technology. This distinction is important because transferring existing paper-based procedures to computers does not necessarily correct inefficient workflows, fragmented records, or weak coordination. Effective digital transformation requires institutions to reconsider how data are collected, processed, shared, and used in providing services.

The Organisation for Economic Co-operation and Development (OECD, 2020) similarly proposed that mature digital government should be digital by design, data-driven, user-driven, open by default, proactive, and supported by government platforms. These dimensions emphasize that digital technologies should be integrated into the entire service cycle rather than added only after administrative procedures have already been established. More recent international assessments indicate that governments have continued to strengthen their digital infrastructures and online services, although institutional capacity, interoperability, inclusion, and user-centered implementation remain uneven across jurisdictions (OECD, 2024; United Nations Department of Economic and Social Affairs [UN DESA], 2024).

The GovTech framework reinforces this institutional perspective by organizing public-sector digital transformation around core government systems, online public service delivery, digital citizen engagement, and enabling conditions such as policies, institutional arrangements, digital skills, and innovation capacity (World Bank, 2022,



2025). This framework is particularly relevant to local governance because the quality of citizen-facing services depends heavily on the internal systems used to maintain records, verify information, monitor transactions, and generate reports. An office may offer digital forms or electronic communication, but service quality will remain limited when its underlying records are incomplete, fragmented, or inaccessible.

These perspectives provide the broader foundation for the present study. BAGIS was not developed merely to convert paper records into electronic files. It was intended to integrate related barangay operations within a centralized platform and improve the flow of administrative information. Its modules for resident profiling, certificate issuance, water billing, inventory management, dashboard monitoring, and reporting reflect the principle that public-sector digitalization should connect internal data management with frontline service delivery.

Barangay Administration and the Need for Digital Systems

Barangays occupy a critical position in Philippine governance because they are the basic political units and the primary planning and implementing units for government programs, projects, and activities at the community level (Republic Act No. 7160, 1991). They also function as the most immediate points of interaction between residents and the government. Their routine responsibilities include maintaining resident and household records, issuing certificates and clearances, documenting local transactions, monitoring community resources, managing certain local services, and preparing administrative reports.

Although these responsibilities require timely and accurate information, many barangay offices continue to depend on logbooks, printed forms, folders, spreadsheets, and separately stored computer files. These methods may remain workable when transaction volumes are limited, but their weaknesses become more evident as records accumulate. Information may be encoded repeatedly, stored under inconsistent formats, misplaced, duplicated, or left outdated. Report preparation may require personnel to consolidate information manually from several sources, while record verification may depend on locating physical files or searching through unrelated spreadsheets.

Certificate issuance illustrates how fragmented records affect frontline services. Barangay clearances and certificates of residency, indigency, and other official documents require the verification of resident information, preparation of the document, recording of the transaction, and maintenance of an issuance history. The integration of barangay clearance into municipal and city permitting procedures further demonstrates that barangay records are connected to broader local government transactions (Department of the Interior and Local Government [DILG], 2019). When resident information and certificate records are stored separately, personnel may repeat data entry and increase the possibility of inconsistent information.

Similar difficulties may occur in water billing, inventory management, and administrative reporting. Billing operations require accurate account information, payment histories, balances, and periodic summaries. Inventory management requires updated records of supplies, equipment, stock movements, and available resources. Reporting requires information from these different areas to be consolidated into usable summaries. A centralized information system can connect these functions, reduce repeated encoding, establish more consistent records, and allow personnel to retrieve or summarize information more efficiently.

The expansion of the Electronic Local Government Unit system across Philippine local government units indicates a broader institutional movement toward digitally enabled local services (DILG, 2025). However, city- and municipal-level digitalization does not automatically address the specific operational requirements of barangays. The present study therefore locates BAGIS within an important implementation space: the extension of digital governance to the grassroots administrative level through a system designed around actual barangay processes.

Integrated Local Government Information Systems



Local government information systems provide the technical infrastructure through which administrative data can be captured, organized, retrieved, updated, and reported. Their value lies not only in faster data entry but also in the integration of records that would otherwise remain dispersed across departments, files, or individual personnel. Integrated systems can establish a common database, standardize data fields, improve transaction traceability, and support consistent reporting.

The literature on data-driven public administration emphasizes that government data should be treated as a strategic institutional resource. Data become useful when they are sufficiently accurate, accessible, reusable, and connected to operational decisions (OECD, 2019). At the barangay level, resident profiles, certificate records, billing histories, inventory transactions, and administrative reports constitute related datasets. Their administrative value is reduced when they are stored in separate locations or formats because users cannot easily verify relationships among records or produce consolidated summaries.

Integration is therefore a central design consideration for BAGIS. The resident profiling module serves as a foundational database that supports other transactions, particularly certificate issuance and resident-related reports. The water billing and inventory modules organize service and resource records, while dashboards and reporting features convert transaction data into summaries for monitoring. This arrangement reflects the literature's emphasis on connecting back-office data management with service functions rather than developing isolated applications for each task.

Nevertheless, system integration must be proportionate to the organizational context. Barangays may operate with limited hardware, unstable connectivity, small staffing complements, varied digital competencies, and restricted technical support. A highly complex system may therefore produce additional burdens rather than operational improvement. The literature suggests that local government systems should be context-sensitive, modular, understandable to non-specialist users, and maintainable within available institutional resources. BAGIS responds to this requirement through a modular structure that prioritizes the barangay functions identified during needs assessment.

Web-Based Administrative Systems

Web-based information systems are accessed through browsers and generally use centralized databases to support data entry, retrieval, updating, and reporting. Their architecture can allow several authorized users to access the same application without installing separate software on every workstation. This arrangement is useful in administrative settings because it reduces dependence on isolated personal files and supports more consistent access to updated records.

For barangay operations, a web-based platform can organize repeated workflows into clearly defined modules. Resident profiling may involve adding, editing, searching, and retrieving records. Certificate issuance may connect verified resident information to standardized templates. Water billing may involve account lookup, computation, payment recording, and balance reporting. Inventory management may require stock-in, stock-out, and summary functions. Placing these activities within one platform can reduce the transfer of information between separate logbooks and files.

However, the effectiveness of web-based systems depends on more than accessibility. The interface must use understandable terminology, logical navigation, readable forms, and consistent commands. System response times must be acceptable, records must be saved and retrieved reliably, and access must be limited according to user responsibilities. These concerns link web-based system design directly to software quality and user acceptability. BAGIS was therefore evaluated not only according to whether its modules were present but also according to whether the system was usable, reliable, efficient, secure, and maintainable.

System Development Through Iterative and User-Centered Processes



Information systems developed for actual organizational settings require continuous interaction between technical developers and intended users. Initial requirements may not fully capture the details of everyday administrative work. Users may recognize missing data fields, unclear menu labels, unnecessary steps, or additional reporting requirements only after interacting with a prototype. Consequently, iterative development is more suitable than treating system development as a single linear sequence.

Agile Software Development emphasizes incremental delivery, user collaboration, responsiveness to change, and repeated testing. In public-sector projects, these principles help developers align technical features with organizational procedures and emerging user requirements. For BAGIS, iterative development allowed administrative problems to be translated into system requirements, prototypes to be tested in actual barangay settings, and user feedback to inform subsequent revisions.

Design Science Research further supports this developmental orientation. It treats an information system as an artifact created to solve an identified organizational problem and requires both the development and evaluation of that artifact (Hevner et al., 2004; Peffers et al., 2007). The value of an artifact is demonstrated not solely by its technical completion but by its relevance to the problem, its performance in the intended context, and the evidence produced through evaluation.

The present study combined these perspectives. The development of BAGIS began with the examination of current administrative processes and user needs. System architecture, database structure, interfaces, modules, access controls, dashboards, and reporting functions were then designed around the identified requirements. Prototype testing, expert validation, pilot observation, user assessment, interviews, and system logs provided evidence for refinement. This process strengthens the connection between the developed system and the operational context in which it is intended to function.

Software Quality and System Validation

The development of a functioning information system does not, by itself, establish its quality. A system may contain the required modules but remain difficult to use, unstable, slow, insecure, or difficult to modify. System validation is therefore necessary to determine whether the technological output satisfies both functional requirements and broader quality expectations.

ISO/IEC 25010:2023 provides a recognized product quality model for evaluating information and communication technology and software products (International Organization for Standardization [ISO], 2023). The model includes quality characteristics that enable researchers and developers to assess whether a system performs its intended functions and possesses the technical qualities required for continued use. The attached study selected functionality, usability, reliability, efficiency, security, and maintainability because these dimensions were directly relevant to BAGIS and its deployment context.

Functionality concerns whether the system provides features that address stated and implied requirements. In BAGIS, this involves the successful performance of resident profiling, certificate issuance, water billing, inventory monitoring, dashboard viewing, and report generation. Functionality must be considered in relation to actual administrative tasks rather than the mere presence of menus or modules.

Usability concerns whether intended users can learn, understand, navigate, and operate the system effectively. This is especially important in barangay offices because personnel may have different levels of digital experience. Clear instructions, familiar terminology, logical navigation, readable interfaces, and consistent procedures can



reduce the effort required to use the system. ISO 9241-11:2018 further situates usability within a context of use, emphasizing effectiveness, efficiency, and satisfaction in achieving specified goals (ISO, 2018).

Reliability refers to the system's capacity to perform consistently under stated conditions. In an administrative system, records must be saved correctly, searches must return appropriate information, and reports must be generated without frequent interruption. Efficiency concerns transaction speed, loading time, resource use, and the number of steps required to complete tasks. These dimensions affect whether users perceive the system as an improvement over manual procedures.

Security is particularly important because BAGIS processes resident information, billing records, user credentials, and administrative transactions. The Data Privacy Act of 2012 requires organizations processing personal information in the Philippines to implement appropriate safeguards and observe principles such as transparency, legitimate purpose, and proportionality (Republic Act No. 10173, 2012). Authentication, role-based access, controlled data handling, secure backups, and activity monitoring are therefore necessary considerations in barangay systems.

Maintainability concerns the capacity to correct, modify, test, and expand a system after implementation. Barangay procedures, certificate templates, report formats, and service requirements may change over time. A system that cannot accommodate such changes may rapidly become obsolete. The inclusion of maintainability in BAGIS validation therefore recognizes that software quality includes the capacity for continued improvement, not merely satisfactory performance during initial testing.

User Acceptability and Actual System Use

Technical validation must be complemented by user evaluation because intended users determine whether a system becomes integrated into routine work. A technically sound system may remain underused when users find it difficult, irrelevant, or unsupported. User acceptability therefore concerns perceptions of usefulness, ease of use, interface clarity, suitability to work, satisfaction, and willingness to continue using the system.

The Unified Theory of Acceptance and Use of Technology explains technology adoption through performance expectancy, effort expectancy, social influence, facilitating conditions, and behavioral intention (Venkatesh et al., 2003). Performance expectancy refers to whether users believe a system will improve their work, while effort expectancy concerns the ease associated with its use. Facilitating conditions include access to equipment, technical assistance, training, policies, and organizational support. These constructs remain applicable to barangay systems because users may accept the practical value of digitalization but still experience barriers related to unfamiliarity, limited infrastructure, or insufficient support.

User acceptability should not be inferred solely from favorable survey responses. Behavioral intention and actual use are related but distinct. Users may report that they intend to use a system while still depending on manual procedures during the early implementation period. Actual use may be influenced by training, availability of encoded records, workload, leadership support, connectivity, system stability, and the compatibility of system features with existing procedures.

The present study addressed this limitation by combining questionnaire results with pilot observation, interviews, and system logs. The survey measured users' perceptions of ease, usefulness, clarity, operational suitability, actual use, and satisfaction. Observations documented whether users could complete major tasks, while system logs provided evidence of module use, transaction activity, errors, and downtime. This triangulated approach provided a stronger basis for determining the acceptability of BAGIS than reliance on a single self-reported measure.

Synthesis and Research Gap



The reviewed literature establishes that digital government can improve public administration when digital technologies are integrated with organizational processes, reliable data, user-centered services, and institutional capacity. It also demonstrates that barangay administration depends on interconnected records and transactions that are difficult to manage through fragmented manual and semi-manual practices. Web-based information systems can centralize these activities, but their usefulness depends on careful requirements analysis, iterative development, software quality, data protection, user acceptability, and continuing technical support.

Despite these advances, several gaps remain. First, much of the digital government literature concentrates on national, regional, municipal, or city-level transformation, with comparatively less attention to the routine information requirements of barangays. Second, locally developed systems often focus on a single function, such as resident records or certificate issuance, rather than integrating resident profiling, certificates, water billing, inventory, dashboards, and reporting within one platform. Third, system evaluations frequently rely on perceived usability or satisfaction without combining expert quality assessment, direct observation, qualitative feedback, and objective system-use evidence. Fourth, many studies evaluate prototypes during limited demonstrations but provide insufficient discussion of maintainability, error handling, downtime, backup procedures, training, and the transition from intended use to routine use. Finally, the operational conditions of small and resource-constrained barangays require systems that are locally adapted rather than assumed to be transferable from larger government units.

BAGIS addressed these gaps by developing an integrated platform for selected administrative operations in four barangays in Mainit, Surigao del Norte. The study connected needs assessment, requirements analysis, iterative development, expert validation based on selected ISO/IEC 25010 criteria, user acceptability assessment, pilot observation, interviews, and system logs. It therefore contributed not only a technological artifact but also context-based evidence concerning the functionality, usability, reliability, efficiency, security, maintainability, acceptance, and actual use of a barangay governance information system.

3. Methodology

Research Design

The study employed a developmental research design to develop, validate, refine, and produce the Barangay Governance Information System (BAGIS) as a functional technological output for local administrative operations. This design was appropriate because the investigation extended beyond describing existing barangay practices and involved the systematic creation and evaluation of an information-system artifact. The study followed the logic of Design Science Research, in which an artifact is developed and evaluated to address an identified organizational problem (Hevner et al., 2004; Peffers et al., 2007). Quantitative and qualitative evidence was incorporated to support system evaluation. Quantitative data were obtained from expert validation ratings, user acceptability questionnaires, observation summaries, and system-log indicators, while qualitative data were generated from interviews, open-ended responses, and pilot observation notes. These data sources were integrated to determine the system's quality, acceptability, operational performance, and required refinements.

System Development Process

The Agile Software Development Model guided the technical development of BAGIS because it supported iterative design, user participation, testing, feedback, and continuous refinement. The development process consisted of eight stages. First, a requirements analysis was conducted to identify existing administrative processes and problems involving resident profiling, certificate issuance, water billing, inventory monitoring, and reporting. Second, the system architecture, database structure, interface, modules, access controls, dashboard, and reporting



functions were designed. Third, a prototype containing the core BAGIS modules was developed. Fourth, the prototype was tested to determine whether users could log in, select modules, complete forms, save records, retrieve information, generate reports, and print or export documents. Fifth, technical experts and intended users evaluated the system. Sixth, users were observed during pilot use to document task completion, navigation behavior, errors, assistance requests, loading delays, and operational interruptions. Seventh, the identified concerns and recommendations were incorporated into the revision and refinement of the system. Finally, the validated version of BAGIS was produced as the principal output of the study.

Research Locale

The study was conducted in Barangays Magpayang, San Jose, Roxas, and Quezon in the Municipality of Mainit, Surigao del Norte. These barangays were purposively selected because their offices performed the administrative functions covered by BAGIS, including resident-record management, certificate issuance, water billing, inventory monitoring, and reporting. The selected sites also provided accessible operational settings and personnel who were available to participate in the needs assessment, pilot testing, system validation, and user evaluation.

Participants and Sampling

The participants consisted of barangay officials and personnel directly involved in the administrative processes supported by BAGIS. These included barangay captains, secretaries, treasurers, kagawads, clerks or encoders, and frontline personnel. Selected information-technology and systems experts also participated in the technical validation of the developed system. Purposive sampling was employed because participation required direct knowledge of barangay administrative operations or relevant technical competence in information-system evaluation. A total of 30 barangay personnel completed the user acceptability assessment following their exposure to and use of BAGIS. The participants were selected for their capacity to provide informed evidence regarding system requirements, operational suitability, usability, performance, and areas requiring improvement.

Research Instruments

Multiple instruments were used to obtain complementary evidence concerning the development and validation of BAGIS. A needs-assessment questionnaire and interview guide were used to document existing administrative procedures, operational problems, user requirements, and recommended system features. The Expert Validation Instrument consisted of 24 items distributed across functionality, usability, reliability, efficiency, security, and maintainability. These criteria were adapted from the ISO/IEC 25010:2023 software product quality model (International Organization for Standardization [ISO], 2023).

The User Acceptability Questionnaire contained 28 items measuring ease of use, usefulness, interface clarity, suitability to barangay operations, overall satisfaction and intention to continue use, and actual system use. The acceptability indicators were informed by the Unified Theory of Acceptance and Use of Technology, particularly performance expectancy, effort expectancy, facilitating conditions, and behavioral intention (Venkatesh et al., 2003). An observation checklist was used during pilot implementation to record successful task completion, navigation difficulties, repeated actions, error messages, assistance requests, loading delays, device limitations, internet interruptions, and power interruptions. A system-log and analytics template captured operational indicators such as login frequency, active users, module usage, transaction completion time, error frequency and type, peak usage periods, and downtime incidents. A system revision matrix was also used to organize identified issues, recommendations, corrective actions, and corresponding system modifications.

Instrument Validation and Reliability



The research instruments underwent content validation to establish their clarity, relevance, coverage, and alignment with the objectives and functions of BAGIS. The expert validation criteria were aligned with ISO/IEC 25010:2023, while the evaluation process was informed by ISO/IEC 25040:2024, which emphasizes defined quality requirements, explicit evaluation criteria, and evidence from intended users and operational use. Advanced construct-validation procedures were not applied because the developmental design and available sample were not suitable for factor-analytic testing.

Internal consistency was assessed using Cronbach's alpha. The 24-item Expert Validation Instrument obtained an overall coefficient of $\alpha = .953$, indicating excellent reliability. Its dimensional coefficients ranged from .883 to .946. The 28-item User Acceptability Questionnaire obtained an overall coefficient of $\alpha = .948$, also indicating excellent reliability, with dimensional coefficients ranging from .847 to .934. All coefficients exceeded the commonly accepted threshold of .70; therefore, all items were retained for data collection.

Data-Gathering Procedure

Permission was first secured from the concerned barangay offices and participants. The study's purpose, procedures, voluntary nature, and intended use of the data were explained before participation. Existing manual and semi-manual administrative practices were then reviewed to determine the problems experienced in resident profiling, certificate issuance, water billing, inventory monitoring, and report generation. Information gathered from intended users was translated into functional, technical, data, interface, and security requirements.

BAGIS was subsequently designed and developed based on the identified requirements. The prototype was presented to intended users and technical validators for testing and evaluation. Participants were oriented on the system and allowed to perform representative administrative tasks. Expert validators completed the software-quality instrument, while barangay personnel completed the user acceptability questionnaire after system exposure. Semi-structured interviews and open-ended responses were collected to explain user ratings and obtain recommendations. Pilot observations were conducted to document actual task performance and difficulties encountered during use. System logs and analytics were then extracted to provide objective evidence of system activity, module use, transaction time, errors, peak usage, and downtime. Finally, all quantitative and qualitative findings were reviewed and entered into the revision matrix to guide the refinement and finalization of BAGIS.

Data Analysis

Frequency and percentage were used to summarize participant responses, identified administrative problems, system requirements, observed task completion, and operational incidents. Mean and overall mean were used to determine the levels of expert validation and user acceptability, while standard deviation was used to describe the variability of ratings. Ranking was applied to identify the strongest and weakest system-quality and acceptability dimensions. Cronbach's alpha was used to assess the internal consistency of the Expert Validation Instrument and User Acceptability Questionnaire.

Qualitative data from interviews, open-ended responses, and observation notes were coded and organized into recurring themes concerning user experiences, system benefits, operational difficulties, support requirements, and recommended improvements. System-log data were analyzed descriptively according to login activity, active users, module usage frequency, transaction duration, error types, peak usage, and downtime. The quantitative, qualitative, observational, and log-based findings were triangulated to provide a comprehensive assessment of BAGIS and to ensure that the final system refinements were grounded in multiple forms of evidence.

Ethical Considerations

Participation was voluntary, and informed consent was secured before data collection. Participants were informed of their right to decline participation or withdraw without penalty. Personal identifiers were excluded from the



reporting of results, and responses were presented only in aggregate or anonymized form. Research data were used exclusively for academic purposes and were handled confidentially. Since BAGIS processed resident and administrative information, access during testing was limited to authorized users through controlled accounts and login restrictions. Sensitive resident-level information was not reproduced in the manuscript. Data handling was undertaken in accordance with the principles of lawful processing, proportionality, confidentiality, and security under the Data Privacy Act of 2012 (Republic Act No. 10173, 2012).

4. Results

Table 1. Existing Local Administrative Operations and Problems That Served as Bases for BAGIS Development

Administrative Area	Existing Process	Identified Problems	Required BAGIS Feature
Resident profiling	Resident and household information was gathered, verified, recorded, and retrieved manually or through separate files.	Records were difficult to retrieve, some entries were incomplete or inaccurate, and data gathering and updating were time-consuming.	Centralized and searchable resident and household profiles, record updating, and report generation
Certificate issuance	Resident information was retrieved, encoded into document templates, printed, and recorded separately.	Processing became slow when templates were unavailable. Manual preparation and repeated encoding were still required.	Automated certificate and clearance generation, stored templates, resident-data retrieval, and transaction recording
Water billing management	Meter readings were collected, bills were computed, payments were monitored, and billing reports were prepared.	Meter reading remained manual. Unreadable meters required flat-rate billing, while payment collection and bill distribution were manually handled.	Automated billing computation, flat-rate billing, balance monitoring, and paid and unpaid account reports
Inventory management	Supplies and materials were monitored through stock-in and stock-out recording.	Stock balances became inaccurate when transactions were not recorded. Updating was repetitive, while hardware and network limitations affected use.	Inventory database, stock-in and stock-out monitoring, low-stock alerts, and supporting-document recording
Reporting and monitoring	Reports were prepared from resident, certificate, billing, inventory, and transaction records.	Data were scattered across separate records, making consolidation slow and prone to error.	Integrated dashboards, searchable records, transaction summaries, and automated report generation

The findings in Table 1 show that barangay administrative work remained largely manual or semi-manual. The common concerns were fragmented records, repeated encoding, slow retrieval, incomplete templates, manual billing procedures, inaccurate inventory updates, and time-consuming report preparation. These problems justified the development of an integrated system rather than separate applications for individual administrative functions.

Functional and Technical Requirements of BAGIS

Table 2. Identified Functional and Technical Requirements of BAGIS

Requirement Category	Identified Requirements	Intended Administrative Benefit
Resident information management	Centralized resident and household records, search, editing, updating, classification, and report generation	Faster retrieval and more accurate resident information
Certificate and	Stored templates, automatic insertion of resident data,	Reduced repeated encoding and

Requirement Category	Identified Requirements	Intended Administrative Benefit
clearance issuance	standardized formatting, printing, and transaction history	faster document issuance
Water billing	Automated computation, meter-reading records, flat-rate billing, balance tracking, payment status, and billing summaries	More accurate billing and improved monitoring of payments
Inventory management	Stock-in and stock-out records, quantity updates, low-stock monitoring, item history, and supporting documents	Better control of supplies and reduced inventory discrepancies
Dashboard and reporting	Real-time summaries, filters, printable reports, and monitoring of key transactions	Faster preparation of administrative reports
User interface	Clear labels, logical navigation, readable forms, and simple task sequences	Easier system use among personnel with varied digital skills
Data and security	Login authentication, user access restrictions, controlled records, and data protection	Protection of resident and administrative information
Technical performance	Stable operation, acceptable loading speed, reliable saving and retrieval, backup, and error handling	Improved continuity and reliability of administrative work
Maintainability	Editable templates, modular design, technical documentation, and capacity for future enhancement	Easier system correction, updating, and expansion

Water billing automation in Table 2 emerged as the most frequently identified need, with 23 coded references. Other prominent requirements included certificate generation, centralized resident profiling, record organization, inventory monitoring, dashboard viewing, and report generation. The requirements were therefore grounded in actual barangay workflows rather than predetermined technical features.

Table 3. Design and Development Features of BAGIS

Design Area	Developed Feature	Evidence from the Results	Interpretation
System architecture	An integrated system composed of interconnected administrative modules	Active modules recorded in the system logs included resident profiling, water billing, certificate issuance, and inventory.	The architecture supported multiple related barangay functions.
Database structure	Organized databases for residents, certificates, billing, inventory, users, and reports	Improved record accuracy and reporting appeared in 15 coded qualitative references.	Centralized storage improved record organization and retrieval.
User interface	Module-based menus, screens, data-entry forms, search tools, and navigation controls	Screen-information clarity obtained a mean of 4.47, while ease of navigation obtained 4.23.	The interface was generally clear, although some users still required assistance.
System modules	Resident profiling, certificate issuance, water billing, inventory management, dashboard, and reporting	Weekly logs recorded 130 resident-profiling transactions, 215 water-billing transactions, 54 certificate transactions, and 23 inventory transactions.	The developed modules corresponded to the major administrative needs.
User access and security	Login authentication and user-level access to system functions	Login was successfully completed in all four observed barangays, although login-related errors were also recorded.	Access controls were operational but required improved stability.
Dashboard and reporting	Monitoring summaries, transaction reports, record	Report generation and printing or export were completed successfully	The reporting features supported retrieval,

Design Area	Developed Feature	Evidence from the Results	Interpretation
	searches, printing, and export functions	in all four barangays.	monitoring, and administrative documentation.
Refinement mechanism	Revision based on user comments, pilot observation, and system logs	Missing templates or modules appeared in 13 coded references, while navigation hesitation and requests for assistance occurred in 75% of barangays.	Continued refinement was needed in templates, navigation, and user support.

The results in Table 3 demonstrate that the developed system closely reflected the administrative requirements identified during the needs assessment. Actual log activity confirmed that the system modules were used during pilot implementation. Water billing registered the highest transaction volume, indicating that this module addressed a substantial operational need.

Table 4. Level of Expert Validation of BAGIS

Validation Criterion	Number of Items	Mean	SD	Verbal Interpretation	Rank
Functionality	4	4.76	0.19	Very High / Strongly Agree	2
Usability	4	4.29	0.38	High / Agree	6
Reliability	4	4.60	0.25	Very High / Strongly Agree	4
Efficiency	4	4.70	0.21	Very High / Strongly Agree	3
Security	4	4.80	0.17	Very High / Strongly Agree	1
Maintainability	4	4.45	0.33	High / Agree	5
Overall	24	4.60	0.19	Very High / Strongly Agree	—

The overall mean of 4.60 in Table 4 indicates that BAGIS met a very high level of expert validation. Security ranked first, suggesting that validators positively assessed its login controls, access restrictions, and protection of administrative data. Functionality ranked second, confirming that the developed modules adequately performed their intended operations. Efficiency and reliability also obtained very high ratings.

Usability obtained the lowest mean, although it remained within the high range. Maintainability was similarly rated high rather than very high. These results identify interface refinement, user guidance, system documentation, error handling, and ease of future modification as areas requiring continued development. The expert ratings were supported by pilot observations showing 100% completion of login, module selection, form completion, record saving, searching, report generation, and printing or export across the four barangays.

Table 5. Level of User Acceptability of BAGIS

User Acceptability Criterion	Related Construct or Indicator	Mean	SD	Verbal Interpretation	Rank
Overall satisfaction and intention to continue use	Behavioral intention	4.77	0.38	Very High / Strongly Agree	1
Usefulness	Performance expectancy	4.76	0.33	Very High / Strongly Agree	2
Suitability to barangay operations	Facilitating conditions	4.42	0.39	High / Agree	3
Clarity of interface and system usability	Usability indicator	4.29	0.38	High / Agree	4
Ease of use	Effort expectancy	4.07	0.60	High / Agree	5
Actual use in assigned tasks	Actual-use indicator	3.79	0.63	High / Agree	6
Overall Mean	All acceptability indicators	4.42	0.30	High / Agree	—

The overall mean of 4.42 in Table 5 shows that BAGIS had a high level of user acceptability. Intention to continue use ranked first, followed closely by usefulness. At the item level, faster completion of barangay transactions obtained the highest mean of 4.87, while improved work productivity obtained 4.80. The users therefore perceived BAGIS primarily as a tool for reducing processing time and improving administrative productivity.

Actual use received the lowest mean of 3.79, despite remaining within the high range. This difference between strong behavioral intention and comparatively lower actual use suggests that system adoption was still at an early stage. Full routinization may require longer implementation, complete data migration, regular training, stronger technical support, and stable system access.

Table 6. Recommended Improvements for BAGIS

Area for Improvement	Recommended Enhancement	Basis in the Findings
Certificate issuance	Add more certificate and clearance templates and allow template editing.	Some required documents remained unavailable, resulting in continued manual preparation.
Water billing	Improve meter-reading functions, include flat-rate billing for unreadable meters, and strengthen balance and payment monitoring.	Water billing received the highest number of coded needs and the highest recorded transaction volume.
Payment facilities	Consider mobile, electronic, or online payment options in future versions.	Billing collection and payment confirmation were still handled manually.
Interface and navigation	Simplify menus, improve prompts, clarify error messages, and reduce repeated clicking.	Hesitation, repeated actions, and requests for assistance were observed in 75% of the barangays.
Login and system stability	Improve login reliability, session handling, timeout controls, and downtime monitoring.	Login-related errors, 85 total errors, and 10 downtime incidents were recorded.
Reporting	Add customizable report types, filters, summaries, and export formats.	Users requested more flexible reports for administrative and monitoring purposes.
User training	Conduct hands-on training and provide a simplified user manual.	Some users required assistance despite successful completion of major tasks.
Technical support	Establish maintenance procedures, troubleshooting support, and issue-reporting mechanisms.	Continued operational use requires immediate support when system errors occur.
Data protection and backup	Strengthen backup, recovery, audit trails, and security monitoring.	BAGIS stores resident, billing, inventory, and transaction information.
Future scalability	Improve maintainability and prepare the system for additional modules and intergovernmental integration.	Maintainability was positively evaluated but remained an area for improvement.

The recommendations in Table 6 indicate that BAGIS was considered useful and operational, but not yet fully optimized for broad implementation. The principal concerns involved feature completeness, system stability, user capability, technical maintenance, and reporting flexibility. These recommendations were incorporated into the refinement process or identified as priorities for succeeding versions.

Table 7. Final BAGIS Output After Validation and Refinement

Final System Component	Main Functions	Validation Evidence
Resident profiling	Recording, updating, searching, retrieving,	Resident profiling was used during pilot

Final System Component	Main Functions	Validation Evidence
module	and reporting resident and household information	implementation and recorded 130 weekly transactions.
Certificate issuance module	Automatic retrieval of resident data, document generation, printing, and transaction recording	Certificate tasks were successfully completed, with 54 weekly transactions recorded.
Water billing module	Billing computation, meter records, payment status, balances, and billing reports	Water billing was the most frequently used module, with 215 weekly transactions.
Inventory module	Stock-in, stock-out, item monitoring, and inventory reporting	The module recorded 23 weekly transactions across the pilot barangays.
Dashboard and reporting	Administrative summaries, monitoring, search, printing, and export	Report generation and printing or export were completed in all observed barangays.
User access and security	Authentication and controlled access to system modules and records	Security obtained the highest expert-validation mean of 4.80.
Refined interface and system functions	Corrections and improvements based on feedback, observation, and system logs	The overall expert-validation mean was 4.60, while overall user acceptability was 4.42.

The final BAGIS in Table 7 integrated the major barangay administrative functions into one system. Its validation was supported by expert ratings, user acceptability results, pilot observations, qualitative feedback, and actual system-log activity. The evidence indicates that BAGIS was functional, highly validated, and accepted by intended users. Nevertheless, the recorded errors, downtime, navigation concerns, and requests for additional features show that the system should continue to undergo technical improvement before wider and longer-term deployment.

Overall Synthesis of Findings

The findings collectively demonstrate that BAGIS responded directly to the fragmentation and inefficiencies of manual and semi-manual barangay administration. The identified operational problems were translated into system requirements, which subsequently guided the development of integrated modules for resident profiling, certificate issuance, water billing, inventory management, dashboards, and reporting. Expert validators rated the system very highly, particularly in security, functionality, efficiency, and reliability. Intended users also evaluated the system positively, especially regarding usefulness and willingness to continue its use.

The triangulated evidence nevertheless distinguishes system validation from complete institutional adoption. All major tasks were successfully performed during pilot use, but actual-use ratings, navigation difficulties, recorded errors, and downtime incidents indicate that longer implementation, regular training, technical support, and system maintenance remain necessary. BAGIS may therefore be regarded as a validated and operational digital administrative system whose broader effectiveness will depend on sustained refinement and institutional support.

5. Conclusion and Recommendations

The study successfully developed and validated the Barangay Governance Information System (BAGIS) as an integrated digital platform for selected local administrative operations in the Municipality of Mainit, Surigao del Norte. The findings confirmed that the existing barangay processes were largely manual or semi-manual and were characterized by fragmented records, repeated encoding, delayed transactions, difficulties in information retrieval, inconsistent reporting, and limited monitoring. These operational concerns were translated into functional and technical requirements that guided the development of modules for resident profiling, certificate issuance, water billing management, inventory management, dashboard monitoring, and report generation. Expert validation showed that BAGIS achieved a very high level of software quality, particularly in security, functionality, efficiency,



and reliability, while user evaluation indicated a high level of acceptability, especially in perceived usefulness, transaction speed, productivity, and intention to continue use. Pilot observations and system logs further confirmed that the major system functions were operational and used during implementation. However, the lower ratings for actual use and ease of use, together with recorded errors, downtime, navigation difficulties, and requests for additional templates and features, indicate that sustained technical refinement and institutional support remain necessary. Overall, BAGIS may be considered a functional, acceptable, and validated information system capable of improving record organization, transaction processing, monitoring, and reporting in barangay administrative operations.

It is recommended that the selected barangays formally adopt BAGIS through a phased implementation strategy supported by clear policies, designated system administrators, regular data updating, and continuous monitoring of system performance. Comprehensive hands-on training should be provided to barangay officials and personnel to improve user confidence, reduce navigation difficulties, and strengthen actual system use. A simplified user manual, troubleshooting guide, and technical support mechanism should also be established. The system should be further enhanced by adding more certificate and clearance templates, editable document formats, improved water-meter and flat-rate billing functions, customizable reports, clearer prompts, stronger error handling, more stable login and session controls, and more reliable backup and recovery procedures. Security measures should be reviewed regularly to protect resident, billing, inventory, and transaction data in accordance with applicable data privacy requirements. Future development may also include mobile access, offline synchronization, electronic payment integration, audit trails, geographic information system functions, and interoperability with municipal or national government platforms. Wider implementation studies should be conducted across additional barangays to assess scalability, long-term system use, user satisfaction, administrative efficiency, and the broader contribution of BAGIS to grassroots digital governance.

Declarations

Ethics Approval and Consent to Participate

The study was conducted in accordance with established ethical principles for research involving human participants. Permission was secured from the concerned barangay offices before data collection and pilot implementation. All participants were informed of the purpose, procedures, expected involvement, voluntary nature, and confidentiality provisions of the study. Informed consent was obtained before participation. Participants were also informed that they could decline or withdraw from the study at any time without penalty. No personally identifying information was disclosed in the presentation of the findings.

Consent for Publication

The author confirms that no personally identifiable information, images, or individual-level data requiring separate consent for publication were included in the manuscript. All reported results were presented in aggregate or anonymized form.

Availability of Data and Materials

The data used and generated in this study are available from the corresponding author upon reasonable request, subject to institutional approval, participant confidentiality, data privacy requirements, and restrictions related to the security of the BAGIS database and system architecture.

Competing Interests

The author declares no competing financial, professional, institutional, or personal interests that could have influenced the conduct, analysis, interpretation, or reporting of the study.



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Author Contributions

Renz Buctuan conceptualized the study, conducted the needs assessment, designed and developed the Barangay Governance Information System, prepared and validated the research instruments, collected and analyzed the data, interpreted the findings, refined the system, and prepared and approved the final manuscript.

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Data Privacy Statement

All data were collected, processed, stored, and reported in accordance with applicable ethical standards and the provisions of Republic Act No. 10173, or the Data Privacy Act of 2012. Access to resident and administrative data during system testing was restricted to authorized users, and sensitive information was excluded from the manuscript.

Use of Artificial Intelligence

Generative artificial intelligence tools were used only for language refinement, organization, and editorial assistance. The author retained full responsibility for the study design, system development, data collection, analysis, interpretation, verification of sources, and final content of the manuscript.

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