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IBCRIS: Development of an Integrated Barangay Civil Registration and Information System Optimizing Data Analytics for Smarter e-Governance of the City of Tayabas

Maria Cecilia G. Cantos [1], Raymond S. Bermudez [2], Farley L. Abrigo[3]

[1] Associate Professor II, School of Information Technology, Colegio de la Ciudad de Tayabas
[2] IT Officer II, Office of the Mayor-ICT Section, City Government of Tayabas
[3] College President/Administrator, Colegio de la Ciudad de Tayabas

Abstract

E-government plays a vital role in modernizing Local Government Units (LGUs). In Tayabas City, the City Civil Registry Office (CCRO) partnered with 66 barangays to implement a localized civil registration system. Despite collecting extensive demographic and vital statistical data, both the CCRO and local barangay offices struggled to extract meaningful insights due to limited data analytics capabilities. To overcome these challenges, the Integrated Barangay Civil Registration and Information System (iBCRIS) was developed. iBCRIS streamlines resident data management and enhances reporting functions to enable data-driven governance. The system was developed using an Agile methodology with a modular architecture, utilizing Laravel for the back-end, Vue.js for the front-end, and MySQL as the database management system. System performance and user satisfaction were evaluated by 69 respondents, comprising 3 LGU representatives and 66 barangay secretaries, across key quality attributes. The results indicated high user satisfaction in security (mean = 4.63), interaction capability (mean = 4.48), performance efficiency (mean = 4.38), and maintainability (mean = 4.29). Functional suitability (mean = 3.99) and reliability (mean = 4.08) yielded moderate scores, identifying key areas for future enhancement. Overall, iBCRIS demonstrates a robust capability to optimize data management and analytics within the Tayabas LGU, laying the foundation for smarter e-governance and improved public service delivery.

Keywords: Barangay civil registration, Information system, Data analytics, e-Governance

1. Introduction

E-government is essential for the modernization of any Local Government Unit (LGU) in the Philippines, as it enhances transparency, accountability, and good governance. It also helps in making the government more results-driven, efficient, and citizen-focused, while enabling citizens and businesses to access government services and information efficiently. The barangay, as the smallest unit of government, plays a crucial role at the foundational level in providing effective and efficient services to the community.

Tayabas City, Philippines, like most Local Government Units (LGUs), depends on its 66 barangays for essential resident data. LGU offices often require raw data on demographics, socioeconomic factors, and similar information. The City Civil Registry Office of Tayabas City, Philippines has recently introduced its own Barangay Civil Registration System with the goal of conducting thorough surveys among the population of the barangays. City Ordinance #21-24 establishes the Barangay Civil Registration System (BCRS) in Tayabas City, outlining the roles and responsibilities of local functionaries in its support. The City Civil Registry Office (CCRO) will use the barangays to personally collect data utilizing the Household Questionnaire designed for this project to bring it to fruition. The CCRO intends to utilize the outdated BCRS system from the Philippine Statistics Authority to establish a data repository. Nevertheless, they are facing glitches and compatibility issues. They resort to using spreadsheet applications, such as Excel, to input the data and set up their database. Their strategy involves supplying laptops to the barangays so they may update and keep the records collected annually. This is where the laborious and troublesome phase may occur. Encountering data anomalies can undermine the reliability of the available data. An information system will centralize the storage of the barangay's data, providing a dependable and conveniently accessible source for situational analysis and program planning.

CCRO started a localized BCRS to provide a functional database of relevant data for LGU offices to improve decision-making. The project's anticipated results include vital data, demographic characteristics, sectoral gender statistics, and civil registration statistics. They want to create reports by hand using spreadsheet software like Excel. While feasible, creating informative reports may be time-consuming and real-time patterns may not be visible. Furthermore, they have not recognized the importance of analytics in extracting insights from the collected and integrated data.

The main objective of this study is to design an integrated barangay civil registration and information system that aims to efficiently manage residents' data from barangays and optimize data analytics to come up with insightful reports that LGU offices and the 66 barangays can use in better decision making leading to smarter e-governance. Furthermore, this study specifically aimed to: 1) gather data related from the LGU regarding typical transactions of barangay and data being collected in relation to the need of various office of the LGU; 2) design the system's functionalities, features, and analytical reports needed; 3) develop the system using appropriate development tools and establish data repository; 4) evaluate the developed system; and 5) deploy the developed system.

2. Objectives of the Study

The main objective of this study is to design an integrated barangay civil registration and information system that aims to efficiently manage residents' data from barangays and optimize data analytics to come up with insightful reports that LGU offices and the 66 barangays can use in better decision making leading to smarter e-governance. Furthermore, this study specifically aimed to:

1. gather data related from the LGU regarding typical transactions of barangay and data being collected in relation to the need of various office of the LGU;
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4. evaluate the developed system; and
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3. Methodology

The primary focus of this study was on system development. Agile methodology was the basis in the system development. Abrahamsoon, Ronkainen, and Warsta (2017) state that agile software development methods aim to meet the need from the corporate community for faster and more flexible software development processes. Agile refers to being prepared for action, quick and skillful in movement. Laury (2017) defines agile as a mindset or methodology that seeks to implement the values and principles outlined in the Agile Manifesto. The Agile methodology, as shown in Figure 1, is characterized by its iterative approach. Each iteration produces functional software that contributes to the whole development process, including supporting elements like documentation, until the final product is finished. Each iteration typically lasts for a duration of two or four weeks and has a set finish time. The iteration process is systematic and limited in scope by the allocated time due to its time-sensitive nature. Utilizing iterative planning and feedback allows teams to consistently adjust a product to meet a client's specific requirements.

Figure 1. Software Development Methodology

Agile development technique commences with Requirement Analysis. Data collection was conducted in this phase to comprehend the necessary requirements for the development process. With the help of the CCRO and the 66 barangays, researchers gained insight into the features of data collected in the Barangay Civil Registration System. These tasks were completed via meetings, document reviews, and research.

Since the project adopted the agile methodology, it is not necessary to fully understand all the business requirements before proceeding to the next step, the Design Phase. The development team can progress with the development even if not all processes are in place. Obtaining the full requirements was achieved through the iterative method. During the requirements planning phase, the continuous system design was completed by generating suitable UML diagrams.

The subsequent stage is the development. The established system design was implemented by writing code. The development phase is subdivided into sub-phases when defined system components are completed simultaneously. This will expedite development in comparison to conventional system development. The analytics development strategy will occur as basic modules are created. This encompasses the testing and validation of the reporting and analytics.

Each module created will undergo a quality assurance procedure to ensure that the intended functionalities are functioning correctly. During this phase, problems and defects can be addressed prior to the system being used. System evaluation will be conducted in this step to assess user approval.
After successfully completing the quality assurance step, the system or its components are ready for deployment. This will occur during the Deployment phase, where the designed system will undergo pilot testing and be utilized in real-world scenarios. The deployment will be carried out correctly with the assistance of the production and technical support provided by the development team.

The phases mentioned will be repeated until the system is fully completed. Any mistakes or bugs identified during the deployment phase will be rectified, and the project will go through the preceding steps once more. Once the features are finished and no significant concerns were identified, the system can be delivered and integrated at the LGU.

4. Results and Discussion

Through series of meetings, brainstorming, and documents review, requirements needed to develop the proposed system was gathered from the LGU regarding typical transactions of Barangay and data being collected in relation to the needs of various office of the LGU.

The functionalities of the system, features and analytical reports needed were designed based on identified requirements using use case diagram. This use case diagram has been created to comprehend the system's context and purpose, identify functional requirements, validate system design, guide implementation and testing, and facilitate communication and cooperation. Below is the use case diagram of the developed system.

Figure 2. Use Case Diagram of the iBCRIS

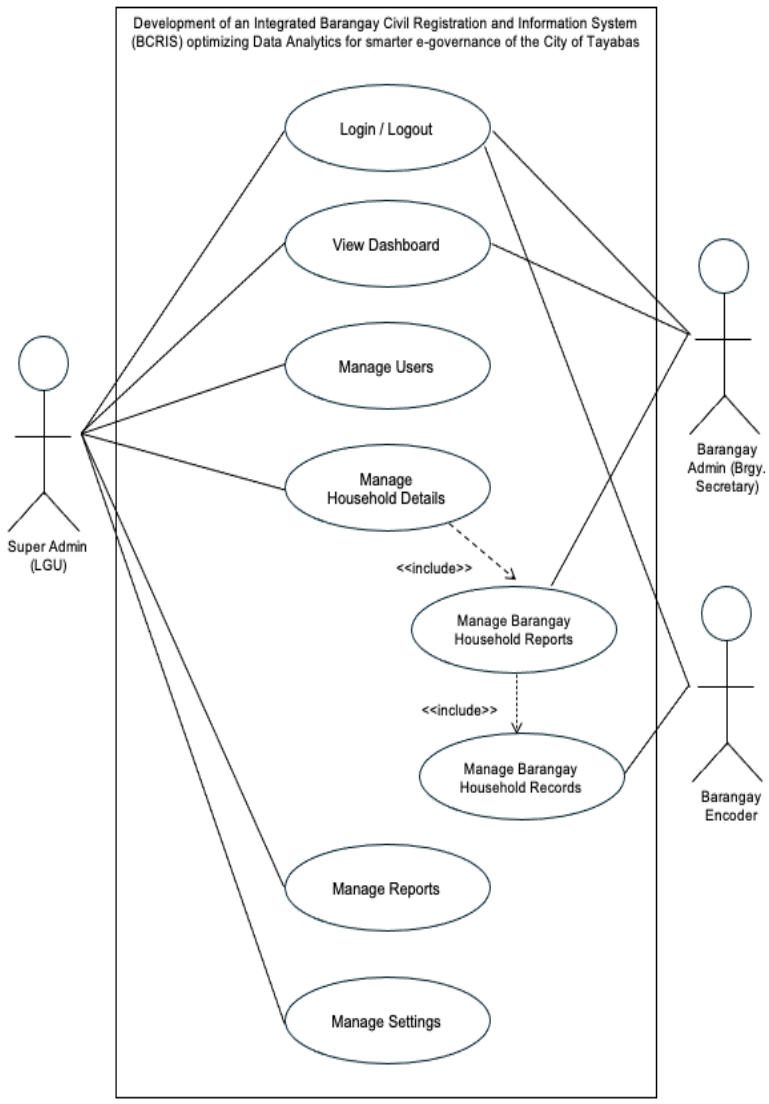


Figure 2 presents the functionalities of the system and the system's requirements from the user's perspective. The system has three actors or users: the super admin (LGU), the barangay admin (brgy. secretary), and the barangay encoder. The administrator oversees the whole operation of the system. While, the barangay secretary can also view the dashboard and manage their barangay household reports. And, the barangay encoder manage only their barangay household records.

iBCRIS was developed using a modular method which is an effective technique for creating intricate systems across many domains. By capitalizing on its advantages and tackling the obstacles, it can result in more effective, sustainable, and flexible system. The user interface of the system, system modules development, system modules testing, and completion of the entire iBCRIS system were accomplished. The functionalities of the iBCRIS were designed and developed using the Laravel framework for the back-end and vue.js for the front-end. MySQL was used for the database.

The iBCRIS identified functionalities were viewing of dashboard, management of users, management of households details, viewing/generating of reports, and management of settings. The following are the screenshots of the developed iBCRIS:

Figure 3. Dashboard

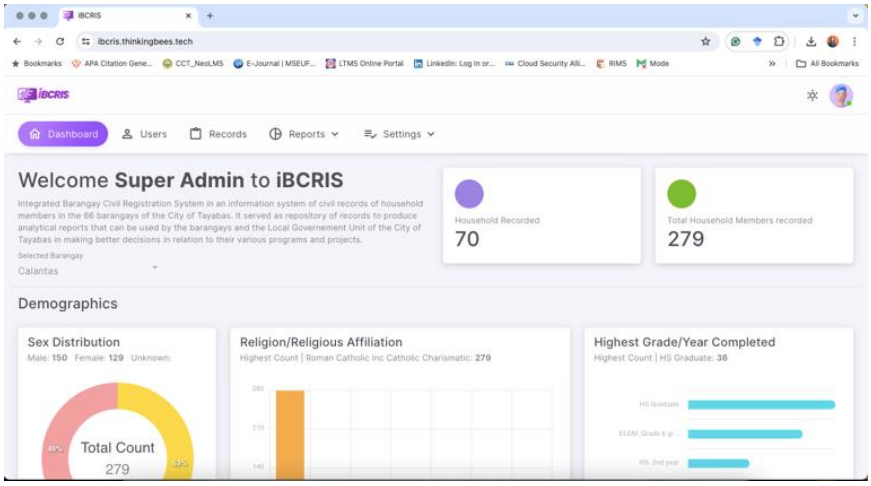
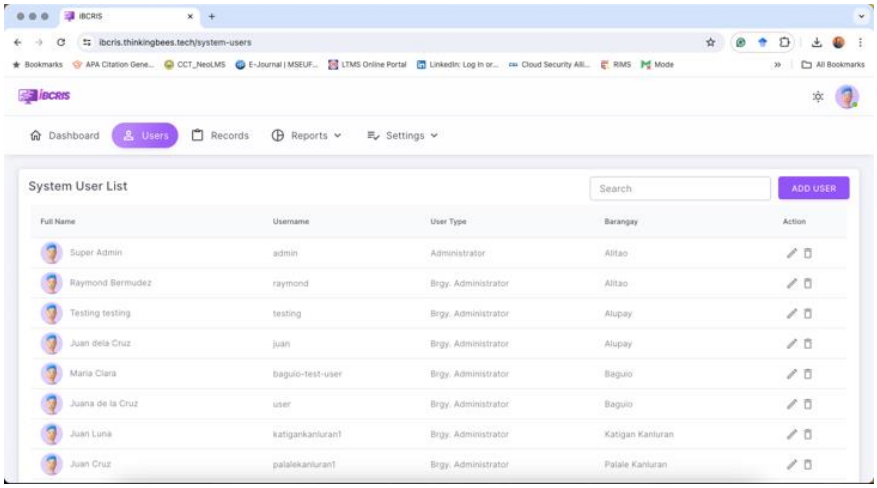


Figure 3 shows the dashboard of the system. The administrator oversees the demographics of the selected Barangay according to the household records and total household members recorded.

Figure 4. User Management



In figure 4, the administrator manages the user account of the would-be-users, where the administrator can add, edit, delete, and view user accounts.

Figure 5. Household List Management

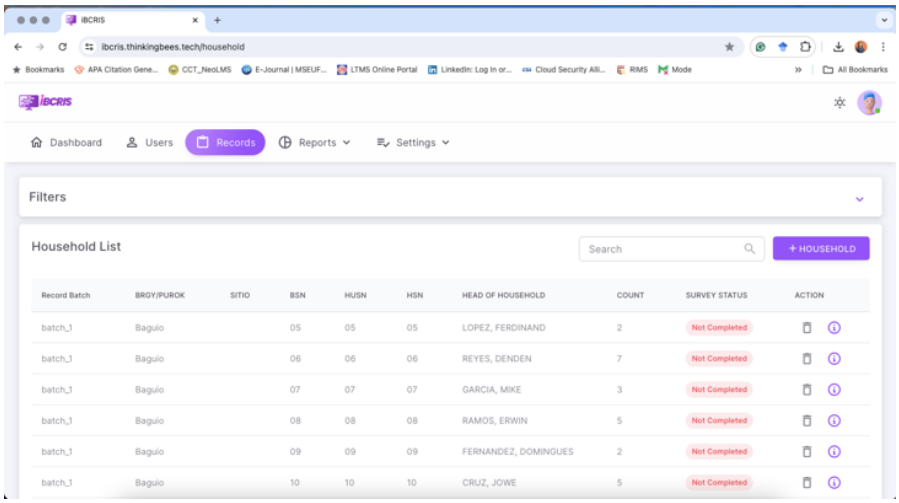
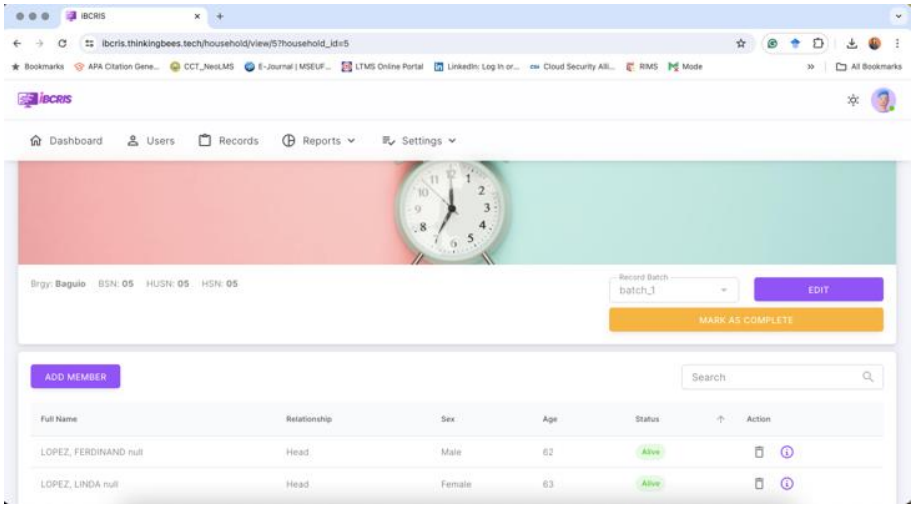


Figure 6. Household Records Management



Figures 5 and 6 illustrate the list of 66 barangays' household details and their records. The administrator can view, add, edit, and update household details such as barangay, BSN, HUSN, HSN, head of household, etc.

Figure 7. View/Generate Reports

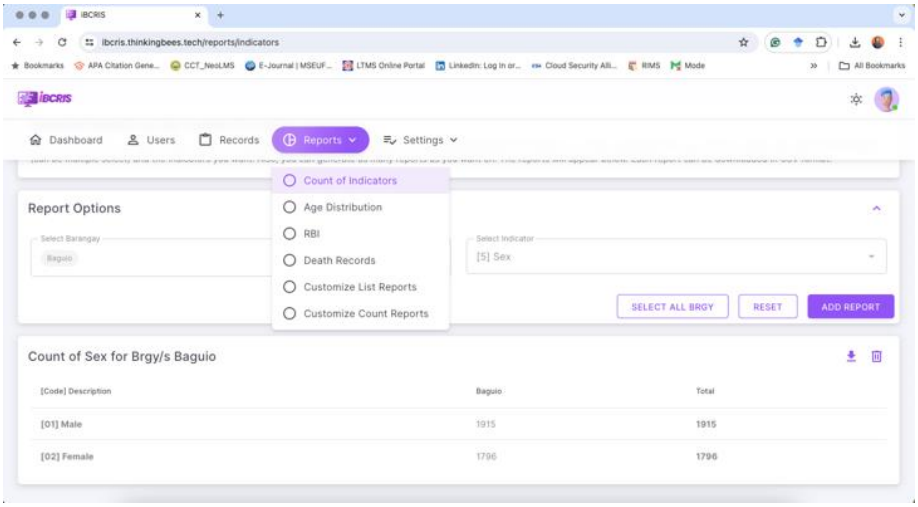


Figure 7 shows the viewing/generating a report from the report options. The administrator can view and generate reports by selecting a specific barangay, start and end dates, and age bracket.

Figure 8. Manage Settings

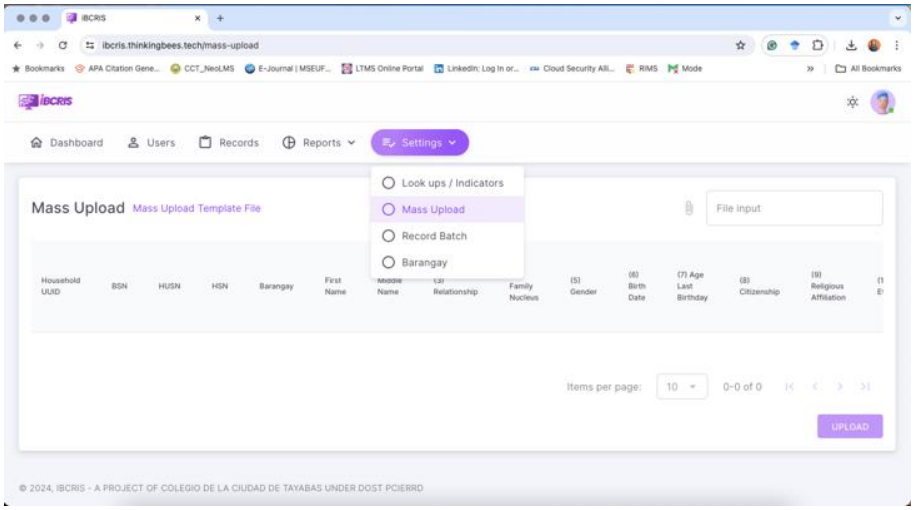


Figure 8 shows the management of settings with different options. The administrator can choose which type of settings will be executed according to the following parameters: look-ups and indicators, mass upload, and record batch.

iBCRIS was evaluated by the end-users. This evaluation was conducted to ensure it achieves its objectives, enhance usability and user experience, and provide insights for future advancements and decision-making. User feedback was collected during the evaluation to offer solid evidence of the system's beneficial effects and to validate the resources allocated to its development and implementation.

The evaluation of the system is a process of comparing the system's requirements and functionalities. The system will be implemented in the actual work environment and used by the target user in real-world scenarios. The system is evaluated to measure quality based on the criteria set by ISO 25010 that

identify 8 main quality characteristics, specifically: (1) functionality, (2) efficiency, (3) compatibility, (4) usability, (5) reliability, (6) security, (7) maintainability, and (8) portability. The data will be interpreted using the five-point Likert scale as shown in table 1.

Table 1: Five-Point Likert Scale

Scale	**Range**	**Verbal Interpretation**
5	4.21 – 5.00	Strongly Agree
4	3.41 – 4.20	Agree
3	2.61 – 3.40	Fair
2	1.81 – 2.60	Disagree
1	1.00 – 1.80	Strongly Disagree

The tool used in the evaluation is a self-made questionnaire that conforms to the ISO 25010 criteria such as (a) functional suitability; (b) performance efficiency; (c) interaction capability; (d) reliability; (e) security; and (f) maintainability, as shown in Tables 2 and 3.

Table 2: Result of LGU Representatives' Evaluation on the iBCRIS

ISO 25010 Criteria	**Weighted Mean**	**Interpretation**
Functional Suitability	4.00	Agree
Performance Efficiency	5.00	Strongly Agree
Interaction Capability	4.89	Strongly Agree
Reliability	4.22	Strongly Agree
Security	5.00	Strongly Agree

Table 3: Result of Barangay Secretaries Evaluation on the iBCRIS

ISO 25010 Criteria	**Weighted Mean**	**Interpretation**
Functional Suitability	3.99	Agree
Performance Efficiency	4.09	Agree
Interaction Capability	4.07	Agree
Reliability	3.94	Agree
Security	4.25	Strongly Agree

The project team then distributed evaluation questionnaires to the respondents and collected their feedback. It was attended by 3 LGU representatives and 66 barangay secretaries. They were asked to respond to an evaluation instrument to validate the system's functionalities as identified by the target users during the requirements analysis phase.

Table 4: Overall Weighted Mean of the Respondents

ISO 25010 Criteria	**Weighted Mean**	**Interpretation**
Functional Suitability	3.99	Agree
Performance Efficiency	4.38	Strongly Agree
Interaction Capability	4.48	Strongly Agree
Reliability	4.08	Agree
Security	4.63	Strongly Agree

Table 4 presents the mean scores of two groups of respondents on different aspects of iBCRIS. The overall mean score for functional suitability is 3.99, performance efficiency is 4.38, interaction capability is 4.48, reliability is 4.08, security is 4.63, and maintainability is 4.29. The values in "strongly agree" indicate that the respondents were highly satisfied with the performance efficiency, interaction capability, security, and maintainability of iBCRIS. On the other hand, functional suitability and reliability received the overall mean score, which means that the respondents were moderately satisfied with these aspects, with mean scores of 3.99 and 4.08, respectively. The overall evaluation of iBCRIS by the respondents was positive, indicating that they were satisfied with its overall performance.

5. Conclusion and Recommendation

Based on the findings of the study, the researchers conclude the following: 1) requirements needed to develop the system was gathered from the LGU regarding typical transactions of Barangay and data being collected in relation to the needs of various office of the LGU; 2) functionalities of the system, features and analytical reports needed were designed based on identified requirements using a use case diagram; 3) iBCRIS was developed using a modular method which is an effective technique for creating intricate systems across many domains; 4) iBCRIS was evaluated by the end-users to ensure it achieves its objectives, enhance usability and user experience, and provide insights for future enhancements and decision-making; and 5) iBCRIS was deployed to the LGU, through the OCM-ICT section office to be accessed online that allows users for frequent releases of new features and updates.

The study's findings led the researchers to draw the following conclusions: 1) the development of the system required gathering requirements from the LGU, including typical transactions in Barangay, and collecting data about the needs of various offices in the LGU; 2) based on the identified requirements, the functionalities of the system, features, and analytical reports needed were designed using a use case diagram; 3) iBCRIS was developed using a modular method, which is an effective technique for creating

complex systems across multiple domains; 4) the end users evaluated iBCRIS to make sure it achieves its goals, improves usability and user experience, and offers insights for future enhancements and decision-making; and 5) iBCRIS was then deployed to the LGU through the OCM-ICT section office and can be accessed online, allowing for frequent releases of new features and updates.Through series of meetings, brainstorming, and documents review, requirements needed to develop the proposed system was gathered from the LGU regarding typical transactions of Barangay and data being collected.

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