

# Bus-To-Go PH: A Dual-Platform Bus Scheduling and Reservation System with Mobile Booking and QR Code E-Ticketing

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## ABSTRACT

A bus scheduling and reservation system with mobile booking and QR code e-ticketing was developed and assessed. Common problems involving provincial bus trips were lengthy terminal line ups, difficult access to available trips information, hassle booking procedure, non-existent advanced seat reservation, and last-minute fare information. A dual-platform system consisted of a web-based application for bus company administrators and an Android application for passengers were designed to solve these problems. Administrative tasks such as company profile setup, bus, terminal, driver, and admin management, schedule creation, fare setting, and reservation transaction reviewing were implemented on the web-based platform. Trip searching, bus type and seat selection, payment method selection, and QR code generation for electronic ticketing were implemented on the mobile application. Technologies used in developing these systems are HTML, CSS, JavaScript for web, Node.js and Firebase with Firebase CLI for server, and Java, Android Studio and Atom IDE for mobile application development. Methodology used was a developmental research design with descriptive evaluation. Ten IT experts using selected ISO/IEC 25010:2023 software product quality criteria evaluated the web-based application. Forty Android end-users using Mobile App Rating Scale's dimensions evaluated the mobile application. Results revealed that the web-based application achieved an overall mean of 4.20 which is interpreted as Good. The android application achieved an overall mean of 4.37 which is interpreted as Excellent. Both systems can be considered functional, usable, and acceptable.

**Keywords** — bus reservation, bus scheduling, e-ticketing, Firebase, mobile booking, QR code, web-based system.

## INTRODUCTION

Public transportation continues to play a vital role in various aspects of economy, mobility, and service. Although buses are still one of the usual modes of transportation for passenger travel within and across Philippine provinces, conventional bus transportation often still makes use of manual or semi-manual processes. Passenger inquiries about schedules, checking of fares, reservation of seats, and confirmation of tickets are a few of the bus processes that may still require traditional procedures. Bus commuters often have to deal with long lines, limited access to timely trip information, and inconvenience when needing to travel and plan ahead of time. Studies conducted on public bus services suggest that automation of ticketing and mobile support can provide passengers with better convenience, accessibility, and efficiency in the public transportation context of developing countries (Sutandi, 2021).

Increasing efficiency in transportation, logistics, infrastructure, and digitalization are priorities set in The Philippine Development Plan 2023–2028 for enabling industries, businesses, and markets to support Filipinos in achieving inclusive economic growth and improved access to services (National Economic and Development Authority [NEDA], 2023). This current national agenda allows for leeway in developing programs with digital platforms that can enhance transportation-inquired services. Further, the increasing trend of digital payment usage among Filipinos can also allow for better feasibility of online payment and reservation systems. Recent statistics from Bangko Sentral ng Pilipinas stated that digital retail payment

transactions make up 57.4% of total monthly retail payment volume and 59.0% of total retail payment value as of 2024, emphasizing the steady rise of electronic acceptance and usage from the public (Bangko Sentral ng Pilipinas [BSP], 2025). Electronic payment adoption has also been linked to improved convenience, efficiency, and readiness to use transportation services that are technology-supported in transportation environments (Aghisna et al., 2025; Wani et al., 2025).

Still, some provincial bus companies lack a consolidated platform that can aid administrators in accessing bus and driver records, managing terminals and schedules, and approving passenger requests for bus reservations. Users themselves may still need to go in-person to terminals to inquire about trip availability, reserve seats, and confirm fare rates. Bus administrators may find it difficult to manage day-to-day and future records about their buses, drivers, terminals, and schedule, as well as user requests for bus reservations if systems are not integrated.

These issues suggest a need to create a computer-based system that will link the administrators' end of scheduling with the passengers' end of reservation. Research into mobile and electronic ticketing practices also suggests that systems allowing passengers to book tickets online can help ease access to tickets and improve overall convenience by lessening dependence on cash transactions (Ferreira et al., 2022; Kusumapratwi & Waluyo, 2023).

A dual-platform bus scheduling and reservation system was developed. It utilizes a web-based platform for administrators and an Android mobile application for passengers. The system allows administrators to manage schedules while passengers can book available bus slots in advance. Passenger-app features allow users to reserve bus seats, view fare information, choose payment methods, monitor reservation transactions, and receive a QR code-based e-ticket. Mobile applications in transportation contexts are useful because they allow users to transact and access ticketing and travel-related features using smartphone devices (Gracz, 2023). Real-time database support was integrated into the system because reservation systems will require constantly updated booking and schedule data across platforms. Firebase Realtime Database was utilized because it is a cloud-hosted database that supports real-time data synchronization across client applications (Google Firebase, 2026).

Software evaluation practices today prioritize quality, usability, and security of current products. Thus, the web-based system was evaluated using selected criteria from ISO/IEC 25010: 2023 software product quality standards, while the mobile application was evaluated using selected dimensions from the Mobile App Rating Scale. ISO/IEC 25010: 2023 is a set of software quality guidelines that include 11 subsystems of quality: functional suitability, performance efficiency, compatibility, usability, presentation, security, reliability, maintainability, portability, quality, and safety (International Organization for Standardization [ISO], 2023). Research has used ISO/IEC 25010: 2011 and its recent 2023 revision to evaluate information systems and software products, which validates its application as a software quality evaluation guideline (Nugraha & Rachman, 2024; Nuzula & Rochimah, 2023). On the other hand, the mobile application was evaluated using the Mobile App Rating Scale, a valid tool used in assessing the quality of mobile applications (Lin et al., 2016). Studies have used the Mobile App Rating Scale to evaluate dimensions of mobile applications such as engagement, functionality, aesthetics, information quality, and subjective quality (Gonzales et al., 2023; Hatem et al., 2022; Raeesi et al., 2022).

The study aimed to develop and evaluate a dual-platform bus scheduling and reservation system with mobile booking capabilities and QR code e-ticketing. The specific objectives are as follows:

1. To develop a web-based system that can be used by bus company administrators to manage bus scheduling.
2. To develop an Android mobile application that allows passengers to reserve and book bus seats.
3. To provide the system with features that allow users to manage bus schedules, reserve bus seats, make fare inquiries, select payment method, and access their QR code e-ticket.

4. To evaluate the web-based system using selected criteria from ISO/IEC 25010: 2023 software product quality standards and evaluate the mobile application using selected dimensions from the Mobile App Rating Scale.

## REVIEW OF RELATED LITERATURE

Digital transformation implementation has become widespread in many aspects of transportation service delivery. Infrastructure development, transport improvement, logistics efficiency, and digital transformation are among prioritized recommendations highlighted in Philippine Development Plan 2023–2028 as economic and social development strategies (NEDA, 2023). With regard to public transportation delivery, aspects such as schedule monitoring, reservations, passenger recording, and transaction handling can be improved with the use of digitalized systems. Cerdan-Chiscano and Darcy (2022) discussed that public transportation management services can improve and provide accessible, inclusive, and user-centered responses if transportation systems act upon passengers' corresponding needs of differentiated groups. Online reservation services allow users to transact or access various services without being physically present at the location. Reservation systems implemented in transportation allows passengers to shorten waiting times in lines, easier view of available schedules, and allows them to plan ahead. Reservation systems for buses allow companies to monitor transactions more efficiently and conveniently allot seats for passengers, as well as update schedules. These applications can be utilized in provinces where passengers tend to travel longer distances and book seats before the day of their actual travel. Sutandi (2021) found a need for e-ticketing implementations to aid in public bus service improvement while Kusumapratwi and Waluyo (2023) found improvements in bus ticket booking through the use of mobile applications.

Increased adoption of digital payments can also enhance development of online reservation systems for transportation. BSP (2025) reported that the country has already exceeded its digital payment goal for 2024, indicating that digitalization of retail payments hiked to 57.4 percent of total monthly retail payment volume (MPPV) and 59.0 percent of total retail payment value (MPV). As people become more accustomed to transactions through digital means, features such as electronic payment can be integrated into systems that offer online booking and reservations. Studies about transportation have also been made about digital payment uses. Wani et al. (2025) discovered that user behavior and mode choice segments affected the implementation of digital payment use for public transportation. Aghisna et al. (2025) discussed cashless transit payment as a factor in improving public transportation payment systems in developing countries.

Mobile applications are commonly implemented for public-facing services due to their ease of access from users' smartphones. Mobile ticket adoption is influenced by usefulness, ease of use, and behavioral intention according to a study done by Ferreira et al. (2022). Another study that incorporated the usage of mobile applications to purchase tickets for public transport was done by Gracz (2023). In this study's application, passengers searched for schedules, reserved seats, selected payment methods, and obtained QR code e-tickets.

Database synchronization became necessary for reservation systems as schedule availability and booking information needs to update across multiple platforms. Firebase Realtime Database is "a cloud-hosted database. It stores data as JSON and synchronizes data between your clients in realtime (Google Firebase, 2026)." Firebase Realtime Database was chosen due to the system needing administrator-side and passenger-side access to updated schedule information and transaction purchases.

Software quality assessments were needed to determine acceptability, function, reliability, security, and adaptability of systems. ISO/IEC 25010: 2023 software product quality model allowed for the analysis of systems based on functional suitability, performance efficiency, compatibility, interaction capability, reliability, security, maintainability, flexibility, and safety (ISO, 2023). These characteristics allow for measured analysis of systems that require user interfacing, transaction processes, and data storage. These recent studies have incorporated the use of ISO/IEC 25010 allowing for further validation of software and information systems utilizing this standardized software quality assessment model (Nugraha & Rachman, 2024; Nuzula & Rochimah, 2023). Mobile apps should be assessed using MARS due to recent studies that

have used MARS as a valid assessment tool for mobile applications. Gonzales et al. (2023) used MARS to evaluate mobile applications implemented during COVID-19 in the Philippines. Hatem et al. (2022) used MARS to evaluate mobile applications used for individuals with rare diseases. Raeesi et al. (2022) used MARS as an assessment tool for HIV/AIDs mobile applications.

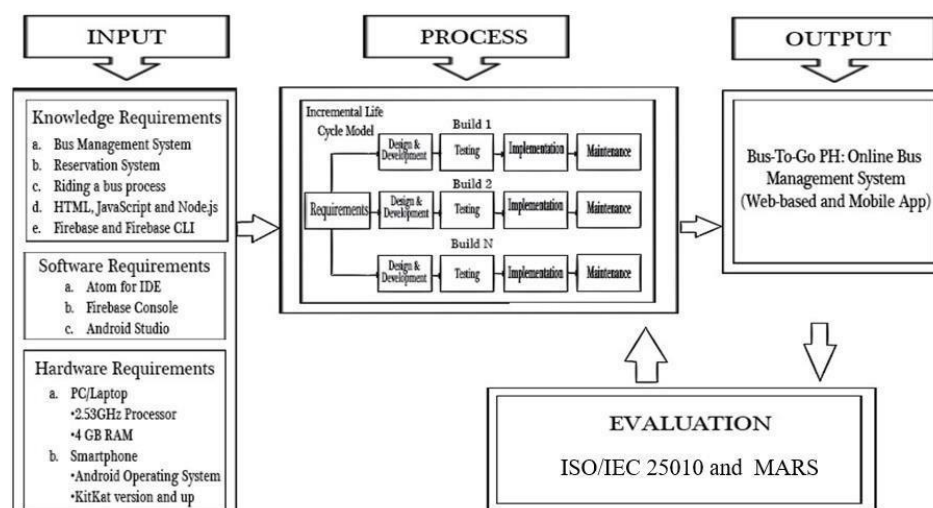
Security is another vital characteristic of web-based and mobile systems. The OWASP Top 10 defines a typical and most significant security risks to web applications and gives directions to developers to aid secure application development (OWASP Foundation, 2025). Security applies to the bus scheduling and reservation system as the system entails users' accounts, reservation data, transaction monitoring system, payment-related processes, and QR code generation and scanning for e-ticketing purposes. Security was also listed as a characteristic of product quality in ISO/IEC 25010:2023, thus making the standard fit to evaluate the security-related quality of the bus scheduling system (ISO, 2023).

In summary, the literature supports building a bus scheduling and reservation system on dual platforms as fit-for-purpose transportation support system. It meets the demands in transport digitalization, online reservation systems, mobile service delivery system, real-time information management system, digital payment method, software quality evaluation using ISO/IEC 25010:2023 and guidelines for building secure systems as well as evaluating mobile application quality.

## Conceptual Framework

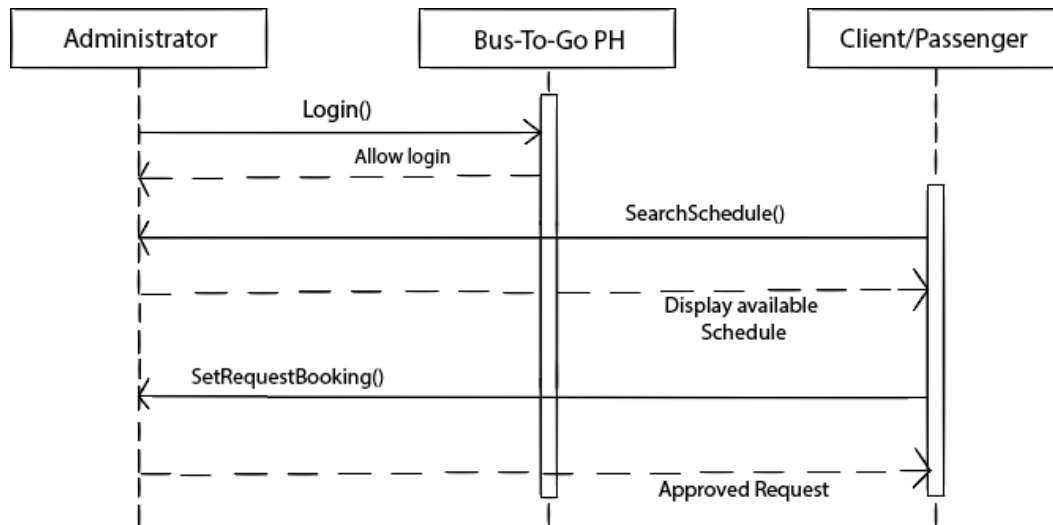
The study utilized the following format: input-process-output. Input of the study consisted of knowledge requirements, software requirements, and hardware requirements. Knowledge requirement consists of concepts on bus scheduling and reservation, fare computation and payment, seat reservation and ticketing process, website creation, mobile app development, and database management Knowledge and Software requirements were learned through research and practicing guides. Required software's included HTML, CSS, JavaScript, Node.js, Firebase, Firebase CLI, Java, Android Studio, and Atom IDE. Hardware requirements included Laptop or Personal Computer for Web development and Android Smartphones for Application compatibility. The process included requirements identification, system design and development, testing, implementation, and maintenance. The methodology of this project followed the Incremental Life Cycle Model which allowed the proponents to finish the entire system through functional increments of the system. The web based-system was designed for bus company owners or administrators while the mobile application was aimed for passengers. Firebase was used as the database that stored and linked the schedule and transaction information for both platforms. Evaluation of the study were done through selected software product quality criteria from ISO/IEC 25010: 2023 for the web based-platform and MARS for mobile application. Output The result of the study is an output of a dual platform bus scheduling and reservation system with mobile booking and QR Code E-ticketing.

Figure 1. Conceptual Framework of the Proposed Project



## System Interaction Flow

Figure 2. Sequence Diagram of Bus-To-Go PH: Online Bus Scheduling and Reservation System



Users that will interact with the system will include the administrator, Bus-To-Go PH system itself, and the client or passenger that will be using our system. Sequence goes as follows: System administrator will log into the web-based system interface and will input his account credentials. The system will validate if the account details that was inputted is valid and then grants access upon pressing the login button. Administrator will then proceed to manage schedules and monitor pending reservation requests from passengers and can approve or process passenger reservations. Client will use his or her smartphone to browse available bus schedules. Client will input his request for desired schedule by selecting his place of origin and destination along with other details about his trip and Bus-To-Go PH System will look for the available schedule inside of the database and outputs the corresponding trips that will be shown in the smartphone's application used by the passenger. Passenger will then input his reservation request by pressing the submit request button on the mobile application. The passenger request will be stored in the system and is then available for administrators to monitor. Administrator then takes note of the passenger's reservation request and processes the request. System will then store the request status as approved and outputs it to the passenger's application. Passenger will then receive the status of his reservation along with his QR code e-ticket.

## METHODOLOGY OF THE STUDY

### Research Design

This study used developmental design and descriptive evaluation. The developmental aspect involved developing and designing of the web-based and mobile apps. The descriptive aspect involved system evaluation based on rating by IT experts and Android end-users. Developmental design was used because the study sought to develop an operational system. Descriptive design was used because the study measured how the respondents viewed the system using structured evaluation questionnaire and weighted mean.

### Participants

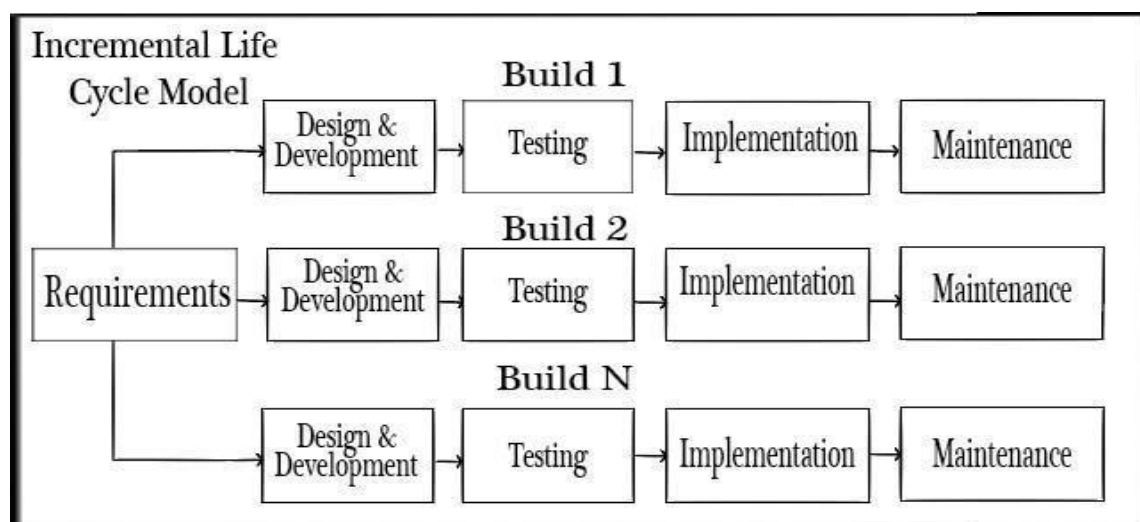
Two sets of respondents were involved in the study. Ten IT experts reviewed the web-based application using selected criteria from ISO/IEC 25010: 2023 software product quality model whereas forty Android end-users reviewed the mobile application using Mobile App Rating Scale dimensions. The former were used because they possessed software product quality knowledge regarding functional suitability, reliability, interaction capability, performance efficiency, maintainability, and flexibility. The latter were used because they represent users that the mobile reservation application is targeted for.

### System Development

The system development life cycle model used is the Incremental Life Cycle Model. This system was developed through several functional builds because the study entailed two integrated platforms – a web-based software for bus company administrators and Android mobile booking application for passengers. The development began by enumerating system requirements. They are administrator login module, add company profile, add buses/drivers, terminal management, add schedule, view/load/fares information, reservation monitoring/report, mobile booking application, seat reservation, payment options, and QR e-ticketing.

Build 1 of the project focused on the web-based version – the schedule and management software. The proponents created, developed, tested, implemented, and maintained administrator access module, asset management module, schedule management module, and reservation/monitoring module. Build 2 focused on the Android mobile booking application. Modules listed above were developed for Build 2 but expounded in aspects of schedule search, passenger information input, type of bus selection, seat reservation, payment options, and generation of QR code. Build N is the linkage or integration of both platforms using Firebase. The schedules entered by the administrator through the web-based platform would then appear in the mobile booking application. Passenger reservations are also monitored by the administrators using the web-based software. After each build, testing, implementation and maintenance were done to remedy errors as well as improve the program's usability, functionality, and performance.

Figure 3. Software Development Life Cycle of Bus-To-Go PH: Online Bus Scheduling and Reservation System Data Collection and Evaluation



Evaluation instruments were derived from selected criteria under ISO/IEC 25010: 2023 software product quality and Mobile App Rating Scale dimensions. Web-based application was assessed by IT experts using functional suitability, reliability, interaction capability, performance efficiency, maintainability, and flexibility subscales. Functional suitability measured how well the system provides functions required for administrators' tasks. Reliability evaluated how well the system performs its tasks without having errors and its capability to recover from errors. Interaction capability measured easiness of use, learnability, and interaction with the system. Performance efficiency evaluated system response time and resource utilization. Maintainability assessed ease with which the system can be corrected, modified, and improved. Flexibility was used to evaluate how well the system adapts to the supported environments and changing requirements. The mobile application was evaluated based on Mobile App Rating Scale dimensions such as engagement, functionality, aesthetics, information quality, and application subjective quality. Respondents were permitted to test the system before filling out the evaluation forms. Collected responses were tabulated and statistically analyzed using weighted mean.

The interpretation scale used in the study was as follows:

Table 1. 5-Point Likert Scale

| Mean Range | Interpretation |
|------------|----------------|
| 4.21–5.00  | Excellent      |
| 3.41–4.20  | Good           |
| 2.61–3.40  | Average        |
| 1.81–2.60  | Fair           |
| 1.00–1.80  | Poor           |

## RESULTS AND DISCUSSION

It was found that both the IT experts and end-users had accepted the dual-platform bus scheduling and reservation system. The web-based application received an overall mean of 4.20 (Good), while the mobile application received an overall mean of 4.37 (Excellent).

### Evaluation of the Mobile Application

Forty Android end-users rated the mobile application using MARS-based questions. Table 2 displays these results.

Table 2. Evaluation Results of the Mobile Application (n=40)

| Criterion                      | Weighted Mean | Interpretation |
|--------------------------------|---------------|----------------|
| Engagement                     | 4.30          | Excellent      |
| Functionality                  | 4.51          | Excellent      |
| Aesthetics                     | 4.45          | Excellent      |
| Information Quality            | 4.28          | Excellent      |
| Application Subjective Quality | 4.32          | Excellent      |
| Overall Mean                   | 4.37          | Excellent      |

The mean rating of satisfaction with the mobile application was 4.37, which was interpreted as Excellent. This means that respondents deemed the application acceptable for use and beneficial in accomplishing bus reservation tasks.

The highest mean rating was 4.51 and was assigned to Functionality. This means that users felt the mobile application was useful in allowing them to perform tasks such as searching schedules, entering passenger information, choosing seats, selecting payment method, and generating a QR code e-ticket. This aspect was highly rated because functionality is one of the dimensions in assessing the quality of mobile applications.

Aesthetics had a mean rating of 4.45 which was interpreted as Excellent. This means that users were generally satisfied with the mobile application's visuals. There is still room for improvement though since certain aspects of the interface could still be tweaked such as the arrangement of buttons and texts as well as making sure that all information on each screen fits on the screen.

Application subjective quality and Engagement were rated 4.32 and 4.30 respectively. This means that users found the mobile application acceptable and engaging to use. Nevertheless, application improvements can still be done such as providing clearer user feedback, adding more instructive and playful guidance, and developing better confirmation messages.

Information quality had the lowest mean rating for the mobile application at 4.28. However, it was still considered as Excellent. Users were able to benefit from the information provided to them by the app. Still,

there is room for improvement such as improving how trip details, fare details, payment instructions, booking reminders, and using the QR code are presented.

#### Evaluation of the Web-Based Application Based on ISO/IEC 25010:2023

Ten IT experts assessed the web-based application with select ISO/IEC 25010:2023 software product quality criteria. The scores can be found in Table 3.

Table 3. Evaluation Results of the Web-Based Application Based on ISO/IEC 25010:2023 Criteria (n=10)

| ISO/IEC 25010:2023 Criterion | Weighted Mean | Interpretation |
|------------------------------|---------------|----------------|
| Functional Suitability       | 4.05          | Good           |
| Reliability                  | 3.87          | Good           |
| Interaction Capability       | 4.13          | Good           |
| Performance Efficiency       | 4.40          | Excellent      |
| Maintainability              | 4.35          | Excellent      |
| Flexibility                  | 4.43          | Excellent      |
| Overall Mean                 | 4.20          | Good           |

The web-based application had an overall mean of 4.20(Good). The experts determined that the administrator-side platform was acceptable to perform bus scheduling, asset management, and reservation transactions. Flexibility had the highest mean of 4.43(Excellent). This indicates that the web-based system may be compatible when interfacing with supported browsers, devices, and operating environments. Performance Efficiency had a mean score of 4.40(Excellent), suggesting that the system responds appropriately to user requests and utilizes time and resources well.

Maintainability had a mean score of 4.35(Excellent). This indicates that the system can be fixed, updated, and enhanced when necessary. The mean score of 4.13(Good) for Interaction Capability indicates that the system is relatively easy to operate. Additional improvements to interface layout, navigation, and user guidance can enhance administrator interaction with the system. Functional Suitability had a mean score of 4.05(Good). This implies that the system functions provide what is required by administrators but can still benefit from additional functions and tighter access control. Reliability had the lowest mean score of 3.87(Good). Work must be done to improve how the system handles errors, backs up data, recovers information, and ensures continuity.

As can be seen in total column, the evaluation showed that the mobile application scored higher than the web-based system. This may be due to the end-users finding the passenger-side reservation process more complete and easier to use. As compared to this, the IT experts were able to pinpoint technical aspects of the web-based system that could use improvement. As a whole, the collected data supports the claim that the system is usable and acceptable. Future development can be focused on improving security, reliability, interface, and preparing the system for deployment. The remaining characteristics in ISO/IEC 25010: 2023 could be evaluated in the future using additional questionnaire items and technical testing. These include compatibility, security, and safety.

## CONCLUSION

The system: Bus-To-Go PH: A Dual-Platform Bus Scheduling and Reservation System with Mobile

Booking and QR Code E- Ticketing was developed successfully. This system had two platforms, the web-based application utilized by bus company administrators and the Android mobile application utilized by passengers.

The web-based application allowed users to create accounts and log-in to the system, recover password, update their company profile, add buses, add drivers, add terminals, create bus schedules, monitor booking requests, and transact. The mobile application allowed users to search for available schedules, select bus type, reserve seats, select payment method, and generate QR codes that can be used as their e-ticket.

Technologies used in the web-based application are HTML, CSS, JavaScript, Node. js, Firebase, Firebase CLI, and Atom IDE. Technologies used in the development of the mobile application are Java and Android Studio. Firebase was used as the online database that stored information from both platforms through its real-time syncing capability.

Web-based Application obtained an overall mean of 4.20 interpreted as Good and the Mobile Application obtained an overall mean of 4.37 interpreted as Excellent. The means were derived from using selected criteria from ISO/IEC 25010: 2023 and Mobile App Rating Scale dimensions, respectively. As a result, the developed system is considered acceptable to its intended users and can be utilized to help provide passengers a more convenient process in bus scheduling and reservation.

It can be concluded that the dual-platform system developed for this study can help passengers avoid problems encountered with manual reservations. Since it allows users to view bus schedules online, reserve seats, know the fare of their reservation, monitor their transactions, and have their ticket validated through a QR code. There are still aspects of the system that can be improved on such as security and reliability, interfaces, search and filtering, payment methods, QR code validation, and real-world deployment.

## RECOMMENDATIONS

The following recommendations are derived from the results of the study:

1. Improve security and access control - Authentication, authorization, password, and user role restriction enforcement should be improved in future versions because reservation system tools receive/store user and transactional information. Development of security could take existing web application security references into consideration (ie. OWASP Top Ten). (OWASP Foundation, 2025)
2. Enhance system reliability - Backup/recovery, graceful error handling, and failed transaction restoration features should be considered in future versions to improve uptime during error states or unforeseen interruption (ie. flaky internet connection).
3. Improve interface design and interaction capability - Improved aesthetics, button placement and organization, screen rendering on various devices, navigability, and ease-of-use should be applied. Labels should be clear and concise. Layouts should be consistent. Consider responsive design.
4. Add search, filtering, and sorting features - Administrators searching the schedule management module should be able to search for specific fields (destination, origin, departure time, bus type, vacant seats, etc.). Likewise, passengers should be able to easily find trips with these fields.
5. Add a seat deselection feature - Passengers should be able to deselect selected seats before submitting their reservation through the mobile application.
6. Expand payment options - Other forms of digital payments can be considered in future versions to allow for increased user payment options. This recommendation is based on Digital Payments momentum in the Philippines. (BSP, 2025)
7. Improve QR code validation - QR Code scan validations should be implemented for terminal/staff

and bus conductor use. This will ensure passenger bookings are validated.

8. Conduct real-world deployment testing - Future studies should recruit actual bus company operators, terminal staff, and passengers to gauge efficacy in a real-world setting.
9. Use the complete ISO/IEC 25010:2023 model for future evaluation - Future studies may consider utilizing all 9 characteristics in the ISOIEC 25010:2023 model. These include: functional suitability, performance efficiency, compatibility, interaction capability, reliability, security, maintainability, and flexibility.
10. Develop an administrative reporting module - Include generation of reservation reports, paid transactions, seat occupancy reports, high-demand routes, passenger volume, and revenue summaries.

## Ethical Approval

This study involved system testing and evaluation by IT experts and Android end-users. Participation should be

voluntary, and the respondents should be informed about the purpose of the study, the confidentiality of their responses, and their right to withdraw from participation. No sensitive personal information should be disclosed in the publication.

## Conflict of Interest

The authors declare that there is no conflict of interest related to the development, evaluation, or publication of this study.

## Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to institutional and ethical restrictions.

## ACKNOWLEDGMENT

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