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Naia Go: Custom Airport Mobile App Designed To Streamline Airport Operations and Enhance Passenger Experience At Ninoy Aquino International Airport

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Abstract

This study's focal point is the development of a customized mobile application that aims to improve passenger satisfaction and operational efficiency at Ninoy Aquino International Airport. The proposed app design provides real-time flight information, baggage tracking, airport navigation, and general public information to enhance service quality. Using a mixed-methods approach, the researchers conducted an online survey with one hundred sixty-five (165) respondents and interviews with two (2) aviation and one (1) software design professionals. The results suggest that the application can significantly contribute to positive passenger experience, particularly in passenger handling and baggage handling. In conclusion, NAIA Go has the potential to transform airport operations and improve the overall traveler experience.

Keywords: custom, mobile app, airport operations, passenger experience, international airport

1. INTRODUCTION

Airport operations worldwide have undergone significant evolution, driven by technological advancements designed to optimize both landside and airside processes. Innovations such as automated check-in systems, advanced air traffic control technologies, and improved baggage handling solutions have revolutionized airport management, leading to greater efficiency, security, and enhanced passenger satisfaction. Despite these advancements, however, many airports continue to struggle with consistently delivering high-quality services, particularly in passenger handling. This is evident at Ninoy Aquino International Airport (NAIA), where persistent operational issues highlight the need for ongoing investment and innovation to address these critical areas.

For instance, an assessment of NAIA's check-in counters revealed frequent congestion and long queues, primarily due to an imbalance in counter utilization (Cedo & Sundo, 2016). Passengers at NAIA experience an average waiting time of 29 minutes, which exceeds the International Air Transport Association (IATA) standard of 20 minutes, indicating inefficiencies in processing times (Dela Cruz & Cruz, 2020). Baggage mishandling remains a significant issue, particularly at Terminal 3 (Seco et al.,

2024), while communication between passengers and airport or airline staff is often lacking (Aragay et al., 2021). Despite efforts to enhance service quality, there remain gaps in key areas such as cashier services, immigration, the information department, and ticketing (Bartolata et al., 2016).

In response to these challenges, airports globally are increasingly adopting advanced technologies to enhance passenger experience and improve operational efficiency. According to Humza & Hacioglu (2023), understanding passenger technology preferences is key to improving airport services and streamlining operations. Many airports are evolving into "smart" facilities by integrating the Industrial Internet of Things (IoT) and tackling emerging challenges, such as the widespread use of smart devices and cybersecurity issues. The goal of these smart airports is to balance growth, efficiency, safety, and security while providing reliable and sustainable services (Lykou et al., 2018).

A major technological advancement in the airport sector is the use of Radio Frequency Identification (RFID) technology, promoted by the International Air Transport Association (IATA). RFID enhances baggage handling by allowing real-time tracking through RFID chips embedded in bag tags, significantly reducing the likelihood of lost or mishandled baggage and enabling instant mobile alerts for passengers (Muruganantham & Joseph, 2020). Additionally, Rashid AI Busaidy, speaking at the International Airport Review Online Summit, highlighted that personalized technologies, such as dedicated airport apps, can significantly improve the passenger experience. These apps can also boost non-aeronautical revenue, collect valuable data, offer self-service options, and promote passenger loyalty through rewards programs (International Airport Review, 2022).

Mobile applications are a crucial component in this transformation, enabling passengers to check in, select seats, and receive mobile boarding passes, all of which help reduce reliance on manual processes and improve operational efficiency (Abdel Rady, 2018). By providing passengers with greater control over their travel experience, airport apps also streamline operations, reduce costs, and differentiate airports from their competitors (Florido-Benítez et al., 2016). For an airport app to be effective, it should feature a user-friendly interface, offering clear and easy navigation, while addressing the diverse needs of passengers to ensure a positive experience (Baláž et al., 2016).

Big Data is increasingly leveraged by airports and airlines to offer personalized services tailored to individual passenger preferences (Saunders, 2017). Mobile apps, in particular, serve as a powerful tool to deliver personalized information and timely updates, making passengers' journeys smoother and more engaging (Kilian et al., 2019). Some applications are designed to assist passengers with navigation, streamline airport processes, and offer alternatives for services, while others focus on marketing and selling products such as food, merchandise, and tickets (Florido-Benítez, 2016). An effective app must balance both functions, recognizing and addressing customer needs while enhancing operational efficiency (Poulaki et al., 2021).

Airlines, through the use of mobile apps, have been able to reduce the cost of passenger services while establishing real-time, interactive communication channels with passengers. Today, efficiency, personalization, and self-service are essential, and advanced technologies have created new opportunities to deliver these capabilities (Poulaki et al., 2021). The growing role of smart airports in driving economic growth is reflected in the projected market value of $9.34 billion by 2030, fueled by increasing security needs and digital transformation (Thaker, 2024).

Automated kiosks and mobile apps are also playing a critical role in improving baggage handling by enabling passengers to independently tag and track their luggage. This reduces wait times, improves customer satisfaction, and ensures real-time updates for a stress-free airport experience (Patel, 2018). The

development of mobile applications has further improved airport navigation, providing passengers with access to real-time information on flight statuses, baggage claims, gate changes, and available services within the terminal (Florido-Benítez, 2016). Features such as GPS integration and QR code scanning further enhance the app's functionality, helping passengers navigate the airport more efficiently (Szymczak, 2018).

Technology offers a significant opportunity to transform the passenger experience and improve the efficiency of airport operations. The concept of a "Smart Airport" represents a comprehensive, technology-driven approach to passenger handling, utilizing automation, to create a personalized, efficient, and seamless airport experience.

1.1. Background of the Study

The Ninoy Aquino International Airport (NAIA) serves as a major gateway to the Philippines, which is essential for linking the country with international destinations. Its key location and accessibility to major cities make it a significant hub for travelers. However, NAIA frequently receives criticism for its service quality, which is often viewed as inferior compared to leading airports in Southeast Asia.

When compared to prominent international airports in Asia, NAIA's services are considered less advanced. Those prominent international airports are known for their top-notch infrastructure, efficiency, and innovative use of technology. They have effectively integrated advanced technologies such as Artificial Intelligence (AI) and the Internet of Things (IoT) to improve passenger experiences. These technologies streamline airport processes and provide real-time updates.

A key feature of these airports is their comprehensive mobile apps, which offer more than just flight information. These apps provide real-time airport navigation, personalized service recommendations, and integration with various airport services, enhancing the travel experience significantly.

The gap in service quality between NAIA and these leading airports underscores the need for modernization at NAIA. Adopting similar technological advancements could help NAIA address its current deficiencies, improve operational efficiency, and enhance passenger satisfaction. This study will explore how implementing AI and IoT technologies at NAIA could elevate its service standards, using successful models from other Southeast Asian airports as a benchmark.

1.2. Theoretical Framework

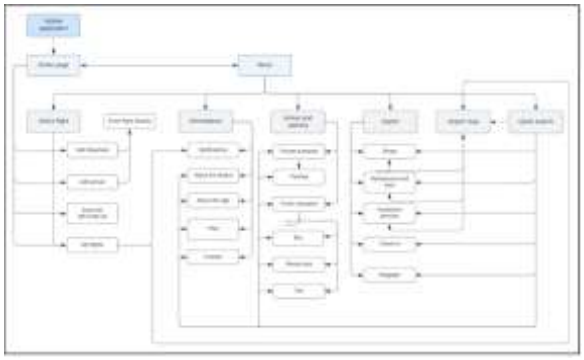

Fig. 1: Information Architecture

In the study done by Baláž et.al. (2023), it was shown that mobile applications should contain a variety of features that will cater to regular customers' needs. Additionally, these features should be easily accessible and should not have a complicated user interface to avoid confusion. As shown in the figure above, the

use of a single menu that categorizes the different features is an effective way to ensure that the average user will be able to navigate through with no worries.

Implementing a custom airport mobile application proposes a smart airport solution that will allow the airport to fully utilize the advantages of modern technology. The application aims to enhance efficiency by ensuring passengers have the information they want at their fingertips, providing passengers with essential information quickly and easily, and minimizing the need for face-to-face interactions. The application offers a range of features designed to enhance passenger experience and streamline airport operations. The key features include Real-Time Flight Information, Online Check-In, Digital Boarding passes, Terminal Navigation and Wayfinding, Payment and Transactions, Personalized Experience, Self-Service Options, and Customer Support.

1.3. Conceptual Framework

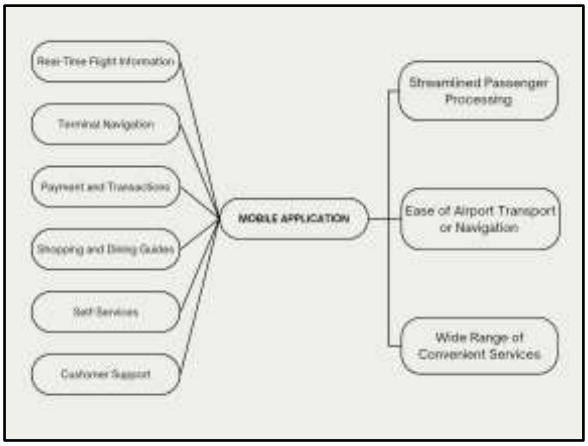

Fig. 2: Diagram of a Centralized Airport Application

The conceptual framework for this study centers on implementing a custom mobile app as its cornerstone. By integrating advanced technologies such as Real-time Data Analytics (RTDA), Artificial Intelligence (AI), and the Internet of Things (IoT), which are designed to enhance passenger experience while streamlining both landside and airside operations, the framework aims to transform Ninoy Aquino International Airport (NAIA) into a Smart Airport. The mobile application serves as a crucial component of this transformation, offering a comprehensive suite of features intended to address current operational inefficiencies and enhance passenger satisfaction.

The application's design presents all its options through a unified centralized menu. Its features include Real-time Flight Information, Terminal Navigation, Payment and Transactions, Shopping and Dining Guides, Self-services, and Customer Support.

1.4. Statement of the Problem

The study aimed to design a custom airport mobile app to streamline airport operations and enhance the passenger experience at Ninoy Aquino International Airport (NAIA).

Specifically, the study sought the answers to the following questions:

1. What are the issues encountered by travel passengers at NAIA? in terms of:
a. Passenger Handling; and
b. Baggage Handling
2. How can an airport mobile app enhance passenger experience by offering a range of convenient services beyond check-in?

3. How can an airport mobile app offer personalized services to improve the overall passenger experience?
4. Is there a significant relationship between the Passenger Handling and Baggage Handling services offered by airport mobile apps and positive passenger experiences in terms of:

a. Age;
b. Sex;
c. Frequency of Flight;
d. Purpose of Flight; and
e. Terminal?

5. Based on the information collected from the respondents, what is their perception on the quality of service at NAIA?
6. Based on the information collected from the respondents, how can an airport mobile app aid in improving the operations at NAIA?

1.5. Hypothesis

There is no significant relationship between the services offered by airport mobile apps and positive passenger experience in terms of age, sex, frequency of flight, purpose of flight, and terminal.

1.6. Significance of the Study

The findings of this study will be beneficial to the following parties:

1. **Air Transportation Students.** The students will benefit from real-world applications and experience of their academic knowledge and enhance their prowess in the field. The introduction and implementation of such modern technologies will pave the way for new job opportunities in the future and make them more competitive in the job market.
2. **Airport Passengers.** This study will benefit the passengers due to reduced waiting time, access to real-time flight information and personal services, and ease of navigation within the airport premises, thus positively reinforcing their travel and airport experiences.
3. **Airport Management and Operations.** Implementing such a mobile application can lead to a more streamlined airport operation, reduce operational costs, improve efficiency, reduce delays, strengthen safety and security, and enhance the overall coordination and effectiveness of the management and its staff.
4. **Airline Companies.** Through an airport application, airline companies can gather valuable information about passenger preferences and, consequently, enhance their passenger services.
5. **Future Researchers.** This study can provide a foundation for further research in the airport management and passenger services sector, and serve as a benchmark for evaluating the effectiveness of mobile applications in airport operations.

2. METHODOLOGY

2.1. Research Design

The research design employed in this study is a mixed-method approach, integrating both quantitative and qualitative methodologies. The quantitative component adopts an Explanatory framework, utilizing questionnaire surveys as the primary instrument for data collection. Data analysis will be conducted through cross-tabulation, facilitating a comprehensive examination of the relationships between variables. On the other hand, the quantitative component of the research design utilized interviews as the instrument for gathering data and was processed through thematic analysis.

2.2. Respondents

The respondents for this survey were selected based on specific criteria to ensure the relevance and reliability of the data gathered. Only individuals aged 18 and above who had previously traveled through the major airport in Pasay City, Philippines, were included. This criterion ensured that all participants had direct experience with air travel via this airport, providing informed and meaningful insights.

To better understand travel behavior, respondents were categorized based on the frequency of their air travel. Three distinct groups were defined: Rarely (once a year); Occasionally (2-3 times a year); and Frequently (more than 3 times a year). These categories helped capture different travel habits, offering valuable insights into how often individuals engage in air travel and their corresponding experiences.

The respondents were also divided into three age brackets to explore generational differences: 18-27 years old (Generation Z); 28-43 years old (Millennials); and 44 years old and above. This age-based classification allowed for an analysis of how different generations perceive and experience air travel, revealing potential trends that could vary between age groups.

Furthermore, the survey distinguished between male and female respondents to examine possible differences in travel behavior and preferences. By considering gender, the study gained a more nuanced understanding of how male and female travelers might experience air travel differently.

By taking into account the variables of age, sex, and travel frequency, the study aimed to provide a comprehensive view of air travel patterns among the respondents. This holistic approach was intended to uncover key trends and insights that could guide more informed decision-making, particularly in the design of the airport's mobile application.

The statistical data on the total number of passengers flying in and out through the airport during the year 2023 was reported to be 45,299,607. This data was collected from the Manila International Airport Authority website (Operational Statistics, n.d.). The data spans from January to December of 2023, providing a comprehensive overview of passenger traffic.

To find the required sample size for the study, Slovins' formula was used, resulting in a sample size of 400 participating passengers. The researchers used both convenience and snowball sampling methods to identify the respondents, ensuring a diverse range of participants for a more representative analysis of passenger perception and experiences at the airport. The researchers garnered a total of 165 respondents and the acceptable response rate was 10 to 15% of the target which is 400. The researchers achieved a response rate of 41.25%.

Age	**Frequency**	**Percentage**
18-27 (Generation Z)	102	61.82%
28-43 (Millennials)	39	23.64%
44 and above	24	14.54%
Total	**165**	**100.00%**

Table 1: Frequency and Percentage Distribution of the Age Bracket of the Respondents

Based on the findings of the survey, 18-27-year-olds (Generation Z) form the absolute majority, making up 61.82% of the respondent passengers. This is followed by 28-43 year olds (Millennials) coming next at 23.64%. Meanwhile, 44 years and above form the smallest minority, making up only 14.5% of the respondents. This is because younger people, with more time and money available at their disposal, can prioritize experience over material possessions and thus often travel more and explore various destinations for leisure, education, or work opportunities. This trend is further supported by the growth of budget airlines and travel deals making flying more accessible to younger travelers, who may be more willing to take advantage of these options.

Sex	**Frequency**	**Percentage**
Male	75	45.45%
Female	90	54.55%
Total	**165**	**100.00%**

Table 2: Frequency and Percentage Distribution of the Sex of the Respondents

The majority of the respondents, 54.55%, identified as Female, while 45.55% of the respondents were male.

Amongst the respondents, 55.2% fly through the airport once a year, with 29.7% flying 2-3 times a year, and 15.2% flying frequently (more than 3 times per year). 80% of the respondents stated that they fly for leisure, while business travel accounts for 12.1%. Terminal 3, which facilitates both domestic and international flights, sees the most traffic from the respondents, 53.9%, while Terminal 4, a domestic terminal, sees the lowest traffic at 2.4%.

The researchers chose three (3) informants for the qualitative aspect of this study. Informants 1 and 2 are professors at an aeronautical school in Parañaque City, Philippines. Before pursuing a profession in the academe, Informants 1 and 2 worked in the commercial airline industry as flight dispatchers. They gained experiences that made them more than qualified to answer the researchers' interview questions. Informant 3 is a software engineer and, therefore, competent to answer questions regarding mobile application design.

2.3. Settings

This research focuses on the issues encountered by passengers at an Airport in Pasay City. The researchers' aim is to identify key problems in passenger services, particularly how passengers are managed and how baggage is handled. It also explores the potential of a mobile application offering personalized services that could help address these issues.

This research enables a focus on the aviation industry's technological innovations that could be applied at an International Airport in Pasay City. The end goal is to develop a mobile application that will improve the efficiency of passenger and baggage handling processes, benefiting both the airport's operations and its passengers.

2.4. Instrumentation

This research utilized a questionnaire to survey participants, developed based on the study's statement of the problem. To ensure accuracy, the researchers used questionnaires relevant to the study, which were

reviewed by validators. The questionnaire contained three problem sets: the first set had 10 items, the second set had 5 items, and the third set had 5 items. Afterward, the questionnaire was revised by the researchers. It was then tested in a pilot survey with 30 students, who responded on a 4-point Likert scale: 4 - Strongly Agree, 3 - Agree, 2 - Disagree, and 1 - Strongly Disagree.

The final survey was based on the questionnaire used in the pilot survey. It contained the same sets of questions but was revised and changed by the researchers. Thus, the final survey included the first set with 11 items, and the second and third sets, each with 5 items. It was disseminated by the researchers through a Google Form link and completed by individuals who had experienced taking a flight.

The interview questions were based on the final survey, which showed significant differences in age, sex, frequency, purpose, and terminal. The questions aimed at furthering the details of these differences. They were designed to gather deeper insights into each factor.

2.5. Data Analysis

To investigate the relationship between passenger demographics, service quality perceptions, and the effectiveness of the airport mobile app, the researchers conducted a comprehensive analysis using both quantitative and qualitative methods. Cross-tabulation and thematic analysis were employed to identify significant differences in passenger perceptions regarding passenger handling and baggage handling, as well as to uncover underlying themes and patterns in their responses. Quantitative analysis involved the use of ANOVA and T-tests to assess the impact of demographics on service ratings. Frequency percentages along with Weighted Means were also used to determine whether there were significant relationships and differences in perceptions based on several factors. Additionally, frequency distributions were calculated to examine the distribution of responses across the 4-point Likert scale categories, providing insights into the overall satisfaction levels of passengers. Significant differences were identified using asterisks; '*' for significant and '**' for very significant, which led to the rejection of the null hypotheses.

Thematic analysis was utilized to further analyze and interpret patterns within the answers of the informants on the interview questions. Through that, researchers found valuable insights that may shed light on the informants' views and experiences. Thematic analysis can be used to uncover underlying meanings embedded inside interview responses and perform a more in-depth exploration to make detailed descriptions of data gathered from the informants.

2.6. Ethical Considerations

The surveys conducted to gather essential data for the research were performed in a manner in which the collection of the data from the participants was held confidential in compliance with the standards prescribed. The respondents of the survey were informed of their privacy, and confidentiality in their contribution to this research, and ensured their data will be secured.

This research mentions Ninoy Aquino International Airport (NAIA) as it focuses on developing a custom mobile application specifically designed to enhance operations and passenger experiences. The inclusion of NAIA is essential to the study's scope and objectives as it serves as the main subject for evaluating the implementation of the proposed application.

An ethical considerations checklist for the research was created to ensure that all ethical standards and guidelines are strictly followed throughout the research process. The researchers made certain that the safety of the respondents was also ensured and that they were in a well-lit setting wherein they had an accessible and safe emergency exit during meetings and discussions. A safe setting for the research was chosen specifically to avoid areas with a high risk of engine emissions, fuel spills, noise pollution, or other

industrial hazards since the site safety procedures fully complied with the standards of the academic institution. The avoidance of bringing large amounts of cash or valuables during activities and the assurance of safety for the participants when leaving the setting where the activity took place were strictly followed during the research process. Preparations for situations where the participants may leave the activity for safety reasons were also performed and the participants guaranteed that they remained uninterrupted from their daily activities while partaking in the research. Participation in this research was completely voluntary and could not potentially harm NAIA or the participants in any way, shape, or form. The topics in this research were ensured to not contain any likelihood of making participants uncomfortable.

The researchers ensured that all ideas, data, and content made by their respective authors have been properly acknowledged hence this research contains no form of plagiarism since all sources and references have been properly cited and all contributions are ethically sound, maintaining honesty throughout the entire research process.

Coordination with representatives, school clinic, security, and participants while the activities took place has been maintained during the research. Obtaining permission and authorization before any research activity or process was performed by the researchers. If the research activities were conducted beyond regular hours, food was provided for both participants and researchers. The social effects of this research, such as the effect of the research team's activities on the daily operations of NAIA and also the effect of helping the airport to enhance the understanding of its operations were analyzed by the researchers.

The NAIA GO app will handle the personal data of the users such as passenger names, and payment details for in-app services. It is vital to adhere to data protection laws such as the Data Privacy Act of 2012, ensuring that all collected data is handled responsibly and highly secure from potential hackers. The Users will be informed about what data is being collected and how it will be used. The Users will also be given the option to opt out of data collection or request deletion of their information.

III. RESULT AND ANALYSIS

3.1. The issues encountered by travel passengers at NAIA in terms of:

3.1.1 Passenger Handling

Statement	Standard Deviation	Weighted Mean	Decision
1.1.1. I find NAIA's check-in counters often clear with short wait times.	0.82938	2.55	Agree
1.1.2. I find that NAIA's check-in process is fast and efficient.	0.77674	2.62	Agree

1.1.3. I find that the staff at NAIA are helpful and responsive to passenger inquiries.	0.59357	3.04	Agree
1.1.4. The signage and directions for check-in counters at NAIA are clear and helpful in reducing wait times.	0.72527	2.93	Agree
1.1.5. I experienced minimal congestion and short queues during the check-in process at NAIA.	0.73378	2.53	Agree

Legend: 3.51 - 4.00 Strongly Agree; 2.51 - 3.50 Agree; 1.51 - 2.50 Disagree; 1.00 - 1.50 Strongly Disagree

Table 3: Passengers' perception of the different issues commonly encountered at NAIA in terms of Passenger Handling.

The study sought to identify the most prevalent issues encountered by passengers traveling through Ninoy Aquino International Airport (NAIA). To achieve this, the first section of the questionnaire focused on evaluating aspects of Passenger Handling, a critical component of airport service delivery. Analysis of the survey data revealed that all questions within this section received average scores ranging from 2 to 3 on a 4-point scale. This indicates a moderate level of satisfaction or agreement among respondents, suggesting room for improvement in passenger handling processes. Furthermore, the standard deviations for each question were all below 1, highlighting a consistent trend in respondents' perceptions. The low variability in responses suggests that the identified issues are shared broadly across the sample population and not isolated to specific groups. These findings underscore the importance of addressing specific pain points in passenger handling to enhance the overall travel experience at NAIA. Further analysis of open-ended responses and demographic data may provide deeper insights into the nature of these issues and potential solutions.

3.1.2 Baggage Handling

Statement	Standard Deviation	Weighted Mean	Decision
1.2.1 The delivery of my baggage always arrives on time after my flight to NAIA.	0.72939	2.77	Agree
1.2.2. My baggage is always handled securely at NAIA.	0.73378	2.76	Agree

1.2.3. The airport personnel at NAIA can effectively address any baggage related issues.	0.70160	2.73	Agree
1.2.4. The condition of my baggage is undamaged upon retrieval at NAIA.	0.67294	2.93	Agree
1.2.5. The baggage handling services at NAIA are as good as other international airports.	0.82805	2.57	Agree

Legend: 3.51 - 4.00 Strongly Agree; 2.51 - 3.50 Agree; 1.51 - 2.50 Disagree; 1.00 - 1.50 Strongly Disagree

Table 4: Passengers' perception on the common issues experienced at NAIA in terms of baggage handling.

The second section of the questionnaire examined passenger perceptions of Baggage Handling services at Ninoy Aquino International Airport (NAIA). Survey results indicate that all responses in this category achieved average scores ranging from 2 to 3 on a 4-point scale. This range corresponds to the "Agree" scale, suggesting that respondents generally perceive the baggage handling operations at NAIA to be somewhat satisfactory. While the results reflect a baseline level of adequacy, the moderate scores highlight potential areas for improvement. It is evident that while passengers do not express outright dissatisfaction, there are opportunities to elevate the quality of baggage handling services to achieve higher satisfaction levels. The findings suggest that NAIA's baggage handling operations are meeting minimum expectations, but further exploration is necessary to identify specific pain points and implement targeted enhancements to exceed passenger expectations.

3.2 How an airport mobile app can enhance passenger experience by offering a range of convenient services beyond check-in

Statement	Standard Deviation	Weighted Mean	Decision
2.1. I would find it helpful to use a mobile application for tracking my luggage, as it gives me instant real-time updates and peace of mind during my journey.	0.59064	3.48	Agree
2.2 My travel experience would be enhanced if I was able to monitor the operational hours of the various shops or services at the airport	0.58907	3.45	Agree
2.3. An airport mobile app would	0.60087	3.48	Agree

improve my experience because it could immediately help me navigate the airport and access specific information relevant to my flight.			
2.4. Instantly having the essential information relevant to my flight or airport facilities directly at my fingertips, minimizing the need for face-to-face interactions, would make my airport experience an enjoyable one.	0.58035	3.49	Agree
2.5. GPS navigation and QR code scanning functions in a mobile application can help streamline airport processes and would greatly enhance my passenger experience.	0.58035	3.49	Agree

Legend: 3.51 - 4.00 Strongly Agree; 2.51 - 3.50 Agree; 1.51 - 2.50 Disagree; 1.00 - 1.50 Strongly Disagree

Table 5: Passengers' insight on various services designed for convenience beyond check-in

Enhancing the passenger experience after check-in via a range of convenient services provided by the airport mobile app is one of the key features that would impact their overall experience in the airport. To properly gauge passenger sentiment regarding the potential benefits of these services and features, a questionnaire survey was conducted. It included five statements about numerous convenient services to help streamline passenger processing, such as real-time luggage tracking, operational hours of airport shops and services, airport navigation, and QR code scanning functions. The results were analyzed using standard deviation and weighted means as the chosen mode of statistical measures. The standard deviation provides discernment into the variability of the responses, while the weighted mean showcases a more precise representation of the average respondent sentiment. Additionally, all statements yielded a weighted mean score between 3.45 and 3.49, which indicates a general agreement among the respondents, suggesting that passengers are open to the idea of using the airport mobile app to enhance their airport experience with convenient services beyond check-in.

3.3 How an airport mobile app can offer personalized services to improve the overall passenger experience

Statement	Standard Deviation	Weighted Mean	Decision
3.1. An airport mobile app should provide individualized flight information based on my trip history.	0.62617	3.42	Agree

3.2. An airport mobile app should have different language options to make it more useful.	0.55861	3.61	Strongly Agree
3.3. An airport app that recalls my preferences such as my favorite seating or airline would make my travel experience easier.	0.62042	3.47	Agree
3.3. An airport app should send push notifications about important details such as changes in flight schedules and baggage claiming schedules.	0.57620	3.57	Strongly Agree
3.5. An airport app should provide personalized directions based on my boarding gate and location to make navigating around the airport easier.	0.57754	3.56	Strongly Agree

Legend: 3.51 - 4.00 Strongly Agree; 2.51 - 3.50 Agree; 1.51 - 2.50 Disagree; 1.00 - 1.50 Strongly Disagree

Table 6: Passengers' insight on various application features that enhance passenger experience

One of the application's purposes is to provide passengers a convenient and easy way to interact with the airport. This can be achieved in a variety of ways, mainly through the addition of application features that have different functions. The results of the questionnaire proved that there are features that are capable of increasing the convenience of interacting with the airport. Language support, GPS-integrated maps, and flight information and history are examples of such features. The features that came out with positive feedback should be considered to be included in the application. Features that came out with negative feedback should be re-adjusted or changed entirely. According to Baláž et.al, (2016), for applications to be effective, the features inside the application should be easy to understand and are simple to navigate. Furthermore, the application should be able to cater to every need of its user to ensure a positive experience in using the application.

Table 6 shows the different features that will positively impact passenger experience as they interact with the airport and its facilities.

3.4 Relationship between the Passenger Handling and Baggage Handling services offered by airport mobile apps and positive passenger experiences in terms of:

A. Age

Group Compared	Significant Relationship	Decision
Passenger Handling and Baggage	0.000	Very significant

Handling		

Legend: ≤ 0.05 Reject, > 0.05 Accept, ≤ 0.01 Very significant

This research examines the relationship between passenger handling and baggage handling services offered by airport mobile apps and their impact on positive passenger experiences. This table specifically aims to identify the significance of age in shaping passenger satisfaction. Passenger handling and baggage handling services are fundamental components of airport operations, and the effectiveness of these services can significantly impact passenger experiences. Age is a crucial factor, as individuals across age groups may interact differently with mobile technology and services, influencing their perception of satisfaction. By investigating this relationship, the study aims to assess whether mobile app features are equally effective for various age groups. The data analysis reveals a value of 0.000, the result falls within the "very significant" threshold, indicating a very significant relationship between age and positive passenger experiences about the services offered by airport mobile apps. The findings indicate that age is a significant factor in the relationship between passenger handling and baggage handling services and positive passenger experiences. The results suggest that passengers of different age groups respond significantly to the services provided by the app, possibly due to varying familiarity with mobile technologies.

B. Sex

Group Compared	Significant Relationship	Decision
Passenger Handling and Baggage Handling	0.000	Very significant

Legend: ≤ 0.05 Reject, > 0.05 Accept, ≤ 0.01 Very significant

This research investigates the relationship between passenger handling and baggage handling services offered by airport mobile apps and positive passenger experiences. This table specifically aims to identify the significance of sex in influencing passenger satisfaction and how services might cater differently to various users. Sex is a factor that can influence how passengers perceive and utilize airport mobile apps. Men and women may have different preferences, behaviors, and expectations when interacting with such technology. Understanding this is essential to designing inclusive and user-friendly applications that enhance overall passenger experiences. The data analysis reveals a value of 0.000, the result falls within the "very significant" threshold, indicating a very significant relationship between sex and positive passenger experiences concerning the services offered by airport mobile apps. The results confirm a very significant relationship between sex and positive passenger experiences, this highlights the importance of considering sex-specific needs and preferences when designing or enhancing the functionality of airport mobile apps to ensure inclusivity and user satisfaction across all demographics.

C. Frequency of Flight

Group Compared	Significant Relationship	Decision
Passenger Handling and Baggage Handling	0.000	Very significant

Legend: ≤ 0.05 Reject, > 0.05 Accept, ≤ 0.01 Very significant

This research explores the relationship between passenger handling and baggage handling services provided by airport mobile apps and positive passenger experiences. This table examines the impact of frequency of flight on the perceived effectiveness of these services, aiming to determine if regular exposure to air travel influences satisfaction. Frequency of flight is an essential factor in understanding passenger behavior and satisfaction. Frequent flyers may have higher expectations and more extensive experience in airport services. Examining this relationship helps assess whether mobile app services cater effectively to passengers with varying travel habits and levels of familiarity. The data analysis reveals a value of 0.000, the result falls within the "very significant" threshold, indicating a very significant relationship between the frequency of flights and positive passenger experiences in relation to the services offered by airport mobile apps. The findings emphasize the need for airport mobile apps to address the requirements of frequent flyers since passengers who fly more often are significantly impacted by the quality and usability of passenger handling and baggage handling services.

D. Purpose

Group Compared	Significant Relationship	Decision
Passenger Handling and Baggage Handling	0.000	Very significant

Legend: ≤ 0.05 Reject, > 0.05 Accept, ≤ 0.01 Very significant

This research investigates the relationship between passenger handling and baggage handling services offered by airport mobile apps and positive passenger experiences. This section specifically focuses on the purpose of flight to determine whether the reason for travel (e.g., business, leisure) influences how passengers perceive and utilize mobile app services. The purpose of a passenger's flight can greatly affect their expectations and usage of airport services, including mobile apps. Business travelers, who typically prioritize efficiency and convenience, may have different app usage patterns compared to leisure travelers, who might value information about amenities or entertainment options. Understanding this is important in designing an app that meets varying needs. The data analysis reveals a value of 0.000, the result falls within the "very significant" threshold, indicating a very significant relationship between the purpose of flight and positive passenger experiences with the services offered by airport mobile apps. These findings suggest that airport mobile apps should account for the varying needs of business and leisure travelers, offering tailored features that enhance satisfaction across different passenger segments and showing that the purpose of travel plays a key role in shaping how passengers interact with airport apps. Passengers traveling for different reasons may have distinct needs, making this an important factor in app design and feature prioritization.

E. Terminal

Group Compared	Significant Relationship	Decision
Passenger Handling and Baggage Handling	0.031	Accept

Legend: ≤ 0.05 Reject, > 0.05 Accept, ≤ 0.01 Very significant

This table focuses on the terminal as a factor, exploring whether the specific terminal used by passengers influences their experience with the mobile app services offered at the airport. The terminal at which passengers travel can have a considerable effect on their overall experience with airport services, including the use of mobile apps. Different terminals may offer varying levels of amenities, service efficiency, and app compatibility, potentially impacting the satisfaction of passengers. Understanding how the terminal factor influences the relationship between passenger handling, baggage handling, and overall passenger experience helps identify areas for improvement in app design and service delivery across different terminals. The data analysis reveals a value of 0.0031, which is greater than 0.01 but still below the threshold of 0.05. This indicates an acceptable relationship between the terminal and positive passenger experience in relation to the services offered by airport mobile apps. While the terminal factor is not as strongly significant as other factors, it still plays a role in shaping satisfaction with mobile app services. Passengers may encounter different levels of efficiency or features depending on the terminal they are using, leading to variations in their overall experience. While not as significant as other factors like age or sex, this result indicates that the specific terminal in use does influence passenger satisfaction to some extent.

Tables 7, 8, 9, 10, and 11 present the participants' insights on the services offered by airport mobile apps, particularly focusing on passenger handling and baggage handling services. The data collected from these tables reveal that there is a very significant relationship between these services and positive passenger experiences, as indicated by the analysis of key factors. The results presented in these tables strongly support the idea that passenger handling and baggage handling services offered by airport mobile apps significantly contribute to positive passenger experiences. The data represents the importance of considering various factors such as age, sex, frequency of flight, purpose of flight, and terminal in the design and development of mobile apps for airports. By addressing the specific needs and preferences of different passenger segments, airport mobile apps can enhance overall user satisfaction, making air travel more efficient and enjoyable for a wide range of passengers.

3.5 Respondents' perception on the quality of service at NAIA

Master Themes	**Superordinate Themes**
Perception on Service Efficiency	● Queue Management
	● Crowding and Passenger Management
Infrastructure and Capacity	● Comparisons with International Standard
Baggage Handling	● Speed of Baggage Services
	● Organization and Security of Baggage

Master Theme 1: Perception on Service Efficiency
Superordinate Theme 1.1: Queue Management
Informant 1: " …I uh experienced huge crowd or uh long line…"

Informant 2: "...I don't think NAIA is capable of handling a large influx of passengers."
Informant 3: "...There is no crowd control unless you are near the check-in counters…"
The perception of service efficiency at airports is greatly affected by how well queues are managed, which in turn influences passengers' overall experience from check-in to boarding. According to informants, NAIA is incapable of accommodating many travelers and is without a proper crowd management system after check-in, which results in terminal-wide congestion and inefficient travel. Technology and open lines of communication in queue management can improve service efficiency, enhance passenger experience, and reduce operational costs. According to (Florido-Benitez L. 2016) the traveler can get all flight information through the app, including take-off time, delays, boarding gates, and more.

Superordinate Theme 1.2: Crowding and Passenger Management
Informant 1: "...especially for check-in counter. …"
Informant 2: "...they are doing a fine job in handling whatever they handle with this type of people…"
size 10 lang text
Crowd management plays a crucial role in moving passengers seamlessly while minimizing the time lost to delays. The importance is realized even more during peak travel hours. According to informants, Technology like check-in kiosks ensure passengers move through the airport with minimal stress. Implementing dynamic crowd management solutions, like guiding passengers to less crowded areas and offering real-time updates through apps or digital signage, enhances both passenger flow and satisfaction. According to Abdel Rady (2018), they can obtain their mobile boarding tickets, choose their seats, and check-in. Mobile apps increase self-service activity, boost reliability, and increase passengers' level of competence.

Master Theme 2: Infrastructure and Capacity
Superordinate Theme 2.1: Comparisons with International Standard
Informant 1: "...I don't think that they're uh competent as with the other airports…"
Informant 2: "...I mean they're not that ready as compared to other countries…"
By measuring local airport facilities and operations against international standards, airports stand to identify those areas needing improvement and thus implement best practices for better service delivery. The informant pointed out that NAIA (Ninoy Aquino International Airport) struggles to compete with airports in other countries, citing problems like outdated facilities, congestion, and inefficient systems that prevent it from meeting international standards. To meet international standards, NAIA must install advanced technologies for a smoother passenger experience, better service delivery, and built-in ability to accommodate higher and higher numbers-in-the-run time efficiency and satisfaction. According to (Bartolata et al. 2016) the cashier services, immigration, informant department, ticketing, and other areas still need attention despite efforts to improve service quality.

Master Theme 3: Baggage Handling
Superordinate Theme 3.1: Speed of Baggage Services
Informant 1:"...So we all know that we are experiencing um delays in baggage, and I do believe that they have maybe older technology in terms of proper handling baggage from different airlines…"
Informant 2: "...It was broken when it came back to NAIA so we had to file a complaint.."

Informant 3: “I have never gotten my baggage damaged at NAIA…”
Baggage handling is a crucial aspect of airport operations. And the efficiency of luggage processing greatly determines the satisfaction of the passengers. According to informants, Efficiency in baggage services is considered among the most critical factors for a passenger to determine how productive an airport is. Using technology and real-time updates to improve baggage handling speeds enhances the passenger experience, minimizes delays, and increases overall operational efficiency. According to (Patel, 2018) automated kiosks and mobile apps speed up baggage handling by enabling travelers to tag and track their bags, cutting down wait times, and offering real-time updates fora stress-free airport experience.

3.6 How an airport mobile app can aid in improving the operations at NAIA

Master Theme	Superordinate Themes
Enhancing Passenger Experience Through Tools	● Convenience and Efficiency
	● Practical and Functional Uses
Improving Passenger Experience through Personalization	● Loyalty and Engagement
	● Personalization and Data-driven Suggestions

Master theme 1: Enhancing Passenger Experience Through Personalization
Superordinate theme 1.1: Convenience and Efficiency
Informant 1: “Actually, that would be a good idea, because in a single application, I would know where the shops and the dining are.”
Informant 2: "Maybe, for example if I'm in a big airport like let's say, what's a big airport, okay let's say Singapore. It's a big airport. I want my app to show me how easy it is to navigate the entire airport or cheaper ways for me to eat somewhere."
Informant 3: "You can provide a map and also list all the establishments at the terminal. Basing it on boarding pass will be easier for simple personalization.

NAIA GO, an application can make the experience of both casual and frequent travelers better by providing features that make interaction with the airport more efficient and convenient. According to the informants, the application must contain features that they will enjoy using as well as convenient to use. Integrating already existing technologies such as Augmented reality in maps or Artificial Intelligence assistance will greatly improve the interaction between the passengers and the application. Florido-Benítez, et al. (2016) noted that airport apps enhance passenger experience and satisfaction by providing convenience, freedom, and choice. They also help airports stand out from competitors, reduce operational costs, and streamline passenger processes, adding value to the user experience.

Superordinate theme 1.2: Practical and Functional Uses
Informant 1: Considering factors like frequent flier status, travel preferences and real-time airport conditions?

Informant 1: I don't know where my gate is, let's say it's on another terminal. So I'm running low on time, so I can use the app to minimize, you know, and save a lot of time.
Informant 3: Provide a countdown timer to boarding time and airport map to the gate.
An application can enhance the passenger experience by providing tools that can significantly impact how they interact with the airport. According to the informants, information such as airport conditions, countdown timers, and maps can significantly increase the usefulness of the application. Including features such as real-time airport conditions, timers of boarding times, maps, and multilingual support will be beneficial to users of the application. According to Abdel Rady (2018), airlines can use mobile apps to provide passengers with essential information like destination details, trip duration, and travel time, allowing them to manage their travel at their convenience.

Master theme 2: Improving Passenger Experience through Personalization
Superordinate theme 2.1: Loyalty and Engagement
Informant 1: So from there the loyalty program, as a passenger, I think that would be more exciting for us as a passenger."
Informant 2: When you use a certain product, or you say, certain airline, you accumulate points. Those points can be converted into something so to a certain services.
An application that keeps track or even gives out loyalty awards will significantly enhance the passenger of users. Based on the informants, the application should have loyalty programs that encourage passengers to use the airport and its facilities. Implementing a feature that keeps track of the shops and airlines that give out loyalty programs will significantly increase passenger experience. The provision of loyalty programs can increase revenue, collect valuable data, strengthen passenger loyalty, and provide a good platform for collecting customer feedback that can be used to further improve the application which benefits both the airport as well as the users (International Airport Review, 2022).

Superordinate theme 2.2: Personalization and Data-driven Suggestions
Informant 3: Basing it on a boarding pass will be easier for simple personalization. You will know their country and their flight destination. Highlight the shops and other facilities along their path to the gate.
An application that contains personalization that is unique to every user by utilizing data-driven suggestions will provide the capability to cater to the needs and wants of every passenger. According to an informant, basing the data on the boarding pass of a passenger is a simple way to personalize the suggestions of the application. By utilizing the path to the gate, the application can highlight the nearby shops or points of interest. The application should have a feature that takes the passengers' position into account. By utilizing this information, the application can point out shops in the area that click with the passengers' interests. According to Humza, et.al (2023), analyzing passenger preferences at airports will help the airport as well as companies within the airport to understand passenger preferences and react accordingly to their needs which will ultimately improve airport efficiency and bolster passenger experience in the process.

IV. DISCUSSION

4.1. Conclusions

Based on the results and analysis, the following were concluded:
4.1.1 It can be inferred that while travel passengers at NAIA express a moderate level of satisfaction with

the airport's Passenger Handling and Baggage Handling services, there remains significant room for improvement. The survey data reveal that the average responses hovered near the midpoint of the scale, suggesting that while basic expectations are being met, the services are not exceeding passenger expectations. This highlights an opportunity for NAIA to enhance its operations and provide a more seamless and satisfying experience for travelers.

4.1.2 Based on the results, the participants collectively agreed that the airport mobile app features and services such as real-time luggage tracking, accurate store and service hour information, airport navigation, timely flight updates, and streamlined processes via GPS and QR code technology would create a more seamless and enjoyable airport journey for the passengers beyond check-in.

4.1.3 The personalized features are designed to enhance the passenger experience at the airport. Participants strongly agree on features to be included such as Language options that will make the application easier to use, Notifications that interact with the users, and Personalized directions that enhance the application's convenience level. Additionally, participants agree on the features: Flight information that is updated in real-time and easily accessible as well as a Preference history that caters to the user's habits.

4.1.4 Results from the data collected from respondents suggest a significant relationship between the passenger handling and baggage handling services offered by airport mobile apps and positive passenger experiences since, after analyzing the data, the majority of the results of the relationship between the passenger handling and baggage handling services offered by airport mobile apps and positive passenger experiences had a very significant outcome, specifically in terms age, sex, frequency of flight, and purpose while the terminal factor yielded an "accept" decision. These results from the participants indicate that implementing a mobile application can significantly enhance passenger experiences due to the diverse features the application can provide.

4.1.5 The data collected from the respondents shows efficient queue management, effective crowd control, and streamlined baggage handling as three main areas for improvement in passenger satisfaction at the airports. With the increased number of passengers and their expectations. Improving operational features to meet international standards will pose more capabilities on how passengers and their needs are handled. Passengers desire a completely smooth and hassle-free journey at the airports with security and speed being the two essential aspects of baggage handling.

4.1.6 Based on the information collected from the respondents, an airport mobile app could significantly enhance the operations at NAIA in terms of convenience, personalization, and efficiency. Respondents suggested features like navigation tools, real-time updates, personal recommendations based on boarding pass information, and data-driven suggestions to optimize the airport experience. The respondents agree that the features for flight tracking, baggage tracking, and navigation would streamline their journey. The respondents also agree that a combination of these features would improve passenger satisfaction and enhance operational efficiency, reduce congestion, and increase engagement with service providers at NAIA, thus creating a more seamless experience for travelers.

4.2. Recommendations

Based on the discussed conclusions, the recommendations are as follows:

4.2.1 The Airport Management should improve their operational efficiency in such a way that the airport can cater to passengers well enough even at peak airport hours and peak flight seasons in terms of Passenger and Baggage Handling.

4.2.2 The Airline Companies can make use of the data from this study as well as the mobile application itself to further improve their services along with the overall airport operations.
4.2.3 Airport Passengers must continue providing feedback through moderators of the airport to gain the appropriate data required to develop new features or improve existing functions of the application. Management and Operations should monitor habits and trends across the market to further improve the effectiveness of data-driven suggestions.
4.2.4 The Airport Management should improve the services currently provided to passengers and baggage handling to make the airport as competent as other airports. An airport mobile application could not only address this issue but also enhance overall airport operations through the various features it could offer for both passengers and baggage handling.
4.2.5 Air Transportation students should study the factors that could affect airport operations and how to mitigate them to make the future of the aviation industry more efficient and reliable.
4.2.6 Future Researchers should look for alternatives or formulate better improvements in the application so that it can follow through with any future innovations in the airport systems.

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