



ĐẠI HỌC QUỐC GIA THÀNH PHỐ HỒ CHÍ MINH
TRƯỜNG ĐẠI HỌC KINH TẾ - LUẬT
KHOA HỆ THỐNG THÔNG TIN



Vietnam Airlines website enhancement

Information System Analysis and Design Course

Group 03
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Commitments

Our team assures that the content of the project: “Vietnam Airlines website enhancement” is honest and authentic and references relevant sources to serve our research purpose. Our group takes full responsibility for any instance of deception or deviation that may arise.

Group 03

Executive Summary

This project aims to enhance Vietnam Airlines' mobile website to address current challenges, streamline operations, and significantly improve the passenger experience. The existing website offers limited functionalities, leading to inefficiencies and customer dissatisfaction, particularly during instances of flight delays or while navigating airport gates. Key upgrades will include features such as real-time GPS navigation to assist passengers in finding their gates and automated vouchers provided for delayed flights, ensuring better customer support. The project follows a hybrid approach combining agile and SDLC methodologies, focusing on the adaptability of the system and its structure. Core activities include requirements gathering, system analysis, process and data modeling, interface design, and back-end development using tools like Figma for mockups and SQL databases to ensure robust data management and scalability. The improved app will be accessible on both Android and iOS platforms, offering a secure and seamless user experience. Upon completion, the enhanced app will deliver multiple benefits, including greater passenger satisfaction, improved operational efficiency, and strengthened brand loyalty by providing a more responsive and user-friendly digital platform. Additionally, automated processes will reduce manual workloads, improving service speed and quality. Critical milestones in the project include finalizing the system design by October 20, 2024, completing development by November 5, 2024, and launching the enhanced app by November 10, 2024. The ISAD document serves as the contractual agreement, aligning system functionalities with Vietnam Airlines' operational needs and ensuring the project meets both technical and business objectives upon delivery.

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List of Abbreviations

No.	Abbreviation	Full Form
1	AD	Adaptability
2	AP	Accuracy and Precision
3	BPMN	Business Process Modeling Notation
4	DFD	Data Flow Diagram
5	EARS	Easy Approach to Requirements Syntax
6	ED	Event-Driven
7	GANTT	Gantt Chart (a project scheduling chart)
8	GPS	Global Positioning System
9	IATA	International Air Transport Association
10	ICAO	International Civil Aviation Organization
11	IO	Information-Oriented Requirements
12	OP	Optional
13	PC	Platform Constraints
14	PERT	Program Evaluation and Review Technique
15	PO	Process-Oriented Requirements
16	POCO	Process Complex Operations
17	POED	Process Event-Driven
18	POOP	Process Optional Operations
19	POU	Process Ubiquitous
20	PR	Performance Requirements
21	PSS	Passenger Service System
22	SC	Security Constraints
23	SD	State-Driven
24	SDLC	System Development Life Cycle

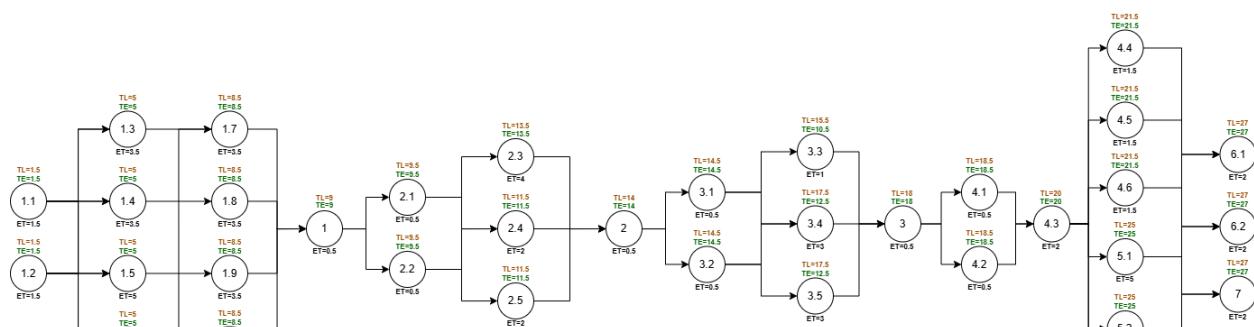
25	SQL	Structured Query Language
26	SSL	Secure Sockets Layer
27	UB	Ubiquitous
28	UAT	User Acceptance Testing
29	UN	Unwanted Behavior
30	XPP	XML Paper Specification

GANTT and PERT Charts

GANTT CHARTS

Project Manager: Nguồn			Display Week:			26/10/2024												2/11/2024											
Task	Assign to	Check	Progress	Start day	Days	End day	26	27	28	29	30	31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
ACKNOWLEDGEMENTS	Vinh	All	100%	6/10/2024	4	9/10/2024																							
COMMITMENTS	Vinh	All	100%	6/10/2024	4	9/10/2024																							
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Executive Summary	Vinh	All	100%	6/10/2024	4	9/10/2024																							
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Gantt chart	Tiến	Vinh	100%	6/10/2024	36	10/11/2024																							
PERT chart	Tiến	Vinh	100%	12/10/2024	9	21/10/2024																							
Part 1 INTRODUCTION TO THE PROJECT																													
1.1 Introduction to the company	Tiến	Vinh	100%	12/10/2024	2	13/10/2024																							
1.2 Deliverables	Tiến	Vinh	100%	12/10/2024	2	13/10/2024																							
1.3 Overview of information system	Quỳnh Anh	Vinh	100%	14/10/2024	4	17/10/2024																							
1.4 Business problems statement	Quỳnh Anh	Vinh	100%	14/10/2024	4	17/10/2024																							
1.5 Proposed solutions	Quỳnh Anh	Vinh	100%	14/10/2024	4	17/10/2024																							
1.6 Business case	Vinh	All	100%	14/10/2024	4	17/10/2024																							
1.7 Project charter	Tài	Vinh	100%	18/10/2024	4	21/10/2024																							
1.8 Assumptions	Khánh	Vinh	100%	18/10/2024	4	21/10/2024																							
1.9 System impacted	Khánh	Vinh	100%	18/10/2024	4	21/10/2024																							
1.10 Introduction to project's methodologies	Khánh	Vinh	100%	18/10/2024	4	21/10/2024																							
Part 2 FACT-FINDING AND REQUIREMENTS MODELING																													
2.1 Introduction to techniques applied for Fact-finding and Requirements modeling	Tiến	Vinh	100%	22/10/2024	1	22/10/2024																							
2.2 Deliverables	Tiến	Vinh	100%	22/10/2024	1	22/10/2024																							
2.3 Current system and system architecture/diagrams (As-is business)	Quỳnh Anh	Vinh	100%	23/10/2024	5	27/10/2024																							
2.4 Business Requirement Documents	Khánh	Vinh	100%	23/10/2024	2	24/10/2024																							
2.5 Systems Requirements Documents	Tài	Vinh	100%	23/10/2024	2	24/10/2024																							
Part 3 DATA AND PROCESS MODELING																													
3.1 Overview and purposes	Tiến	Vinh	100%	27/10/2024	4	31/10/2024																							
3.2 Deliverables	Tiến	Vinh	100%	27/10/2024	1	27/10/2024																							
3.3 Recommended functions	Tiến	Vinh	100%	27/10/2024	1	27/10/2024																							
3.4 Business process Modeling (BPMN) for the new system	Quỳnh Anh	Vinh	100%	28/10/2024	4	31/10/2024																							
3.5 Requirement modeling by DFD (Data Flow Diagram)	Vinh	All	100%	28/10/2024	4	31/10/2024																							
Part 4 Object modeling																													
4.1 Overview and purposes	Tiến	Vinh	100%	1/11/2024	1	1/11/2024																							
4.2 Deliverables	Tiến	Vinh	100%	1/11/2024	1	1/11/2024																							
4.3 Scenarios, Models and Functionality	All	All	100%	2/11/2024	3	4/11/2024																							
4.4 Class Diagram	Tài	Vinh	100%	4/11/2024	2	5/11/2024																							
4.5 Sequence diagram	Vinh	Vinh	100%	4/11/2024	2	5/11/2024																							
4.6 Activity Diagram	Quỳnh Anh	Vinh	100%	4/11/2024	2	5/11/2024																							
Part 5 User interface design and data design																													
5.1 User interface design	Tiến	Quỳnh Anh	100%	4/11/2024	6	9/11/2024																							
5.2 Validation	Quỳnh Anh	Khánh	100%	4/11/2024	6	9/11/2024																							
5.3 Database design	Tài	Vinh	100%	4/11/2024	6	9/11/2024																							
Part 6 Project Plan																													
6.1 Work Breakdown Structure	Vinh	All	100%	8/11/2024	2	9/11/2024																							
6.2 Project Milestones	Vinh	All	100%	8/11/2024	2	9/11/2024																							
Part 7 Lessons learned	All	All	100%	8/11/2024	2	9/11/2024																							

PERT CHARTS



Part 1. Introduction to the project

1.1 Introduction to the company

Vietnam Airlines' journey toward becoming a leading airline has been marked by a steady evolution and strategic growth. Founded in 1956 with the establishment of the Civil Aviation Department, the Vietnamese aviation industry started modestly with a fleet of only five propeller aircraft. Vietnam's inaugural flight took off in September of the same year, marking the first step in the nation's air transport history.

From 1976 to 1988, Vietnam's flight network expanded to include international destinations such as China, Cambodia, Malaysia, Singapore, the Philippines, and Laos, and Vietnam Civil Aviation joined the International Civil Aviation Organization (ICAO), signaling Vietnam's entry into the global aviation community. This foundation laid the groundwork for the formation of Vietnam Airlines in 1993 and, later, the Vietnam Airlines Corporation in 1995, with Vietnam Airlines as the core entity. The airline's iconic Golden Lotus logo was introduced in 2002, symbolizing Vietnamese cultural values of strength, grace, and purity.

As the airline grew, it achieved significant milestones in safety and quality. In 2006, Vietnam Airlines obtained the International Air Transport Association (IATA) Safety Certificate, joining IATA and reinforcing its commitment to international safety standards. Four years later, in 2010, Vietnam Airlines became the 10th member of the SkyTeam global airline alliance, increasing its global reach. By 2016, Vietnam Airlines had gained recognition as a 4-star airline by SkyTrax, underscoring its dedication to service quality.

Today, Vietnam Airlines operates an extensive flight network encompassing 21 domestic destinations and 28 international destinations across 26 countries and territories, providing key domestic routes such as Hanoi, Ho Chi Minh City, and Da Nang, along with international connections to cities like Tokyo, Seoul, and New York. Its aircrafts, painted in the brand's signature blue with a Golden Lotus symbol on the tail, reflect a strong national identity and commitment to excellence. A notable aircraft in the fleet, the 12th Airbus A350, features a unique SkyTeam livery, symbolizing its partnership with the global alliance.

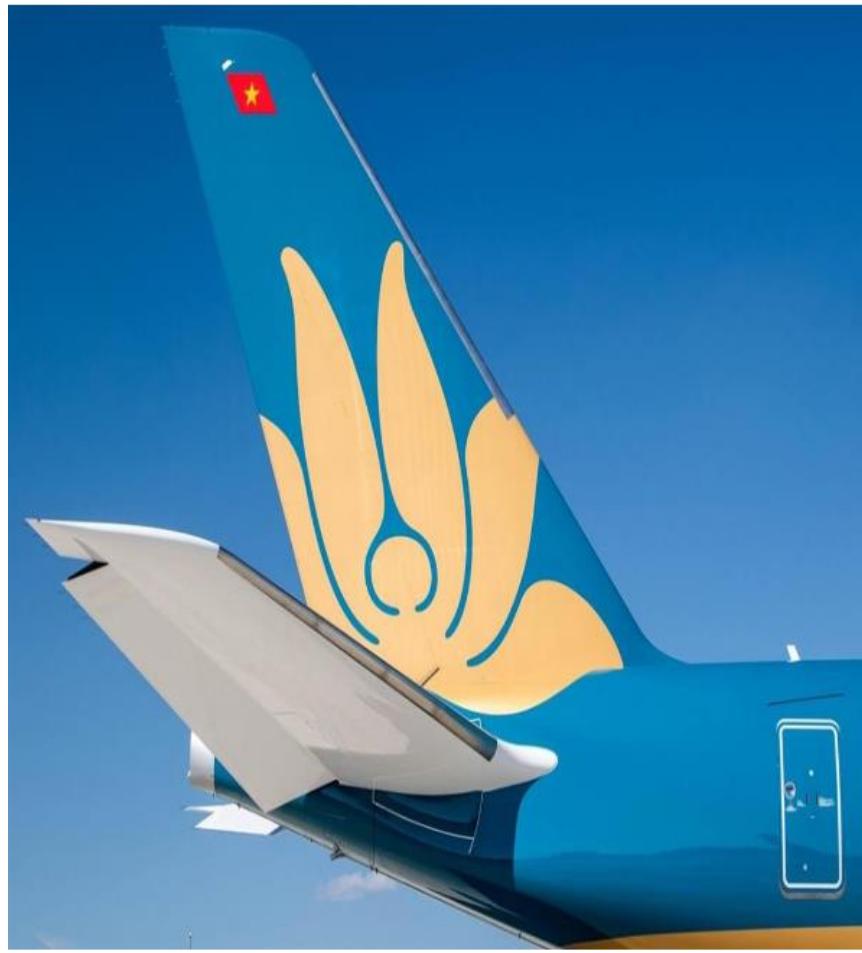


Figure 1.1: Golden Lotus - Symbol of Vietnam Airlines (Source: Vietnam Airlines)

The Golden Lotus logo holds profound significance, symbolizing values that resonate with the Vietnamese people. Representing enlightenment and grace, the Lotus reflects Vietnam Airlines' dedication to quality, sophistication, and resilience. The yellow color symbolizes luxury and excellence, aligning with the airline's brand vision.

Vietnam Airlines' mission focuses on maintaining its position as a leading aviation corporation in Vietnam, emphasizing the importance of market share in the domestic market while also aspiring to be a preferred airline in Asia. The airline strives to deliver high-quality services that meet customer needs, while fostering a professional and supportive work environment that encourages employee growth. Key principles guiding Vietnam Airlines include prioritizing safety, centering customer satisfaction, valuing employees, fostering continuous innovation, and promoting responsible business practices.

These core values reflect Vietnam Airlines' vision to achieve sustainable growth while building customer trust and contributing to the nation's transportation infrastructure.

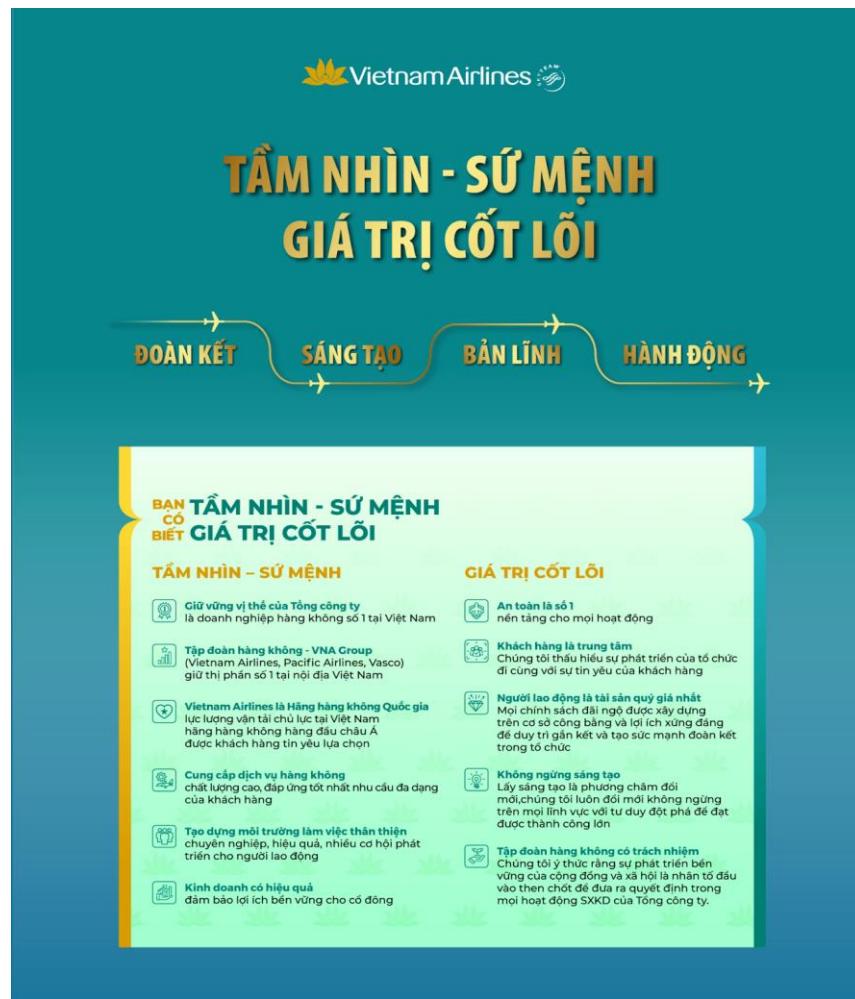


Figure 1.2: Vision - Mission and Cost Values of Vietnam Airlines (Source: Vietnam Airlines)

1.2 Deliverables

1.2.1 Automated vouchers for delayed flights

First, the flight delay tracking system will be a key component, integrated directly into the mobile application. The system will track flight delays in real-time and automatically classify them into levels: less than 2 hours, 2 to 5 hours, and more than 5 hours. This ensures that passengers receive accurate and timely updates on the status of their flight delays.

Next is the coupon issuance system. For flights delayed less than 2 hours, the application will automatically generate and send coupons for food and beverage outlets in the airport to passengers. These coupons are only valid at the airport and have a certain expiration date. For flights delayed from 2 to 5 hours, passengers will receive a 10% discount voucher for their next flight ticket along with the option to change their flight for free. For flights delayed more than 5 hours, the system will issue a 20% discount voucher for their flight ticket and provide the option to change their flight for free.

Integrating the coupon system with partners is important. Airlines need to establish partnerships with airport food outlets to accept coupons from passengers. In addition, the system needs to be designed so that coupons can be easily authenticated and redeemed at the outlets via QR codes or in-app methods. The system also needs to integrate with Vietnam Airlines' booking system so that coupons can be automatically applied to subsequent bookings.

In terms of accommodation support, for flights delayed by more than 5 hours, the app will connect with hotel partners to assist in arranging accommodation for passengers. A direct booking feature will be integrated into the app, allowing passengers to book accommodation immediately without having to leave the app. The app will also send notifications to passengers about accommodation options, including hotel location and transportation information.

Finally, an in-app customer communication system will help inform passengers about flight delays, compensation benefits, and how to use coupons or rebook flights. The system should provide information in a clear, concise manner and support multiple languages to

suit international passengers. Notifications will be sent via push notifications, SMS messages or emails, depending on the passenger's choice.

To improve the passenger experience, the system will include the option to rate the service. Passengers can rate their experience with the compensation system, thereby providing feedback for Vietnam Airlines to improve issuance time and service quality.

1.2.2 GPS Functionality for Gate Location

Integrating GPS functionality into the mobile application will help passengers easily locate the gate, reducing confusion when moving around large airports. This function will provide real-time directions from the passenger's current location to the gate. This is especially useful for passengers with limited time between flights or in the event of a flight delay, helping them make the most of their time moving around the airport.

To implement this function, the application needs to be integrated with a detailed map of the airport, updating information about the gates and areas within the airport. It is important to cooperate with airports to provide accurate data on the location of the gates. The system needs to be designed to be continuously updated, ensuring that gate information is not outdated, especially when there are last-minute changes to the gate. The application also needs to be flexible to display these updates in an intuitive and easy-to-understand manner.

Additionally, this GPS functionality needs to be designed to optimize the user experience in crowded and stressful environments like airports. The navigation functionality in the app includes options like voice guidance, visual maps with easy-to-follow directions, and alerts when passengers are close to the gate or if there are any changes to the exit gate. These features will help passengers feel less anxious and more comfortable navigating, even if they are unfamiliar with the airport.

Another important part of the system is to ensure that the app is compatible with flight-related changes such as gate changes or flight changes. When there are any changes, the app must be quick to update and send notifications to passengers, providing the latest information about the exit gate or directions to the new gate. This helps avoid getting lost or mistaking the gate, especially in cases where the exit gate is changed at the last minute.

Finally, the user experience will be further enhanced if this GPS function is integrated with airport service information. For example, while traveling to the exit gate, the application can suggest nearby amenities such as restaurants, cafes or duty-free shops, helping passengers enjoy a more comfortable and convenient waiting time. With these features, the GPS function that helps identify the departure gate is not only a navigation tool but also contributes to enhancing the overall passenger experience at the airport, bringing convenience and ease during the travel process.

1.3 Overview of information system

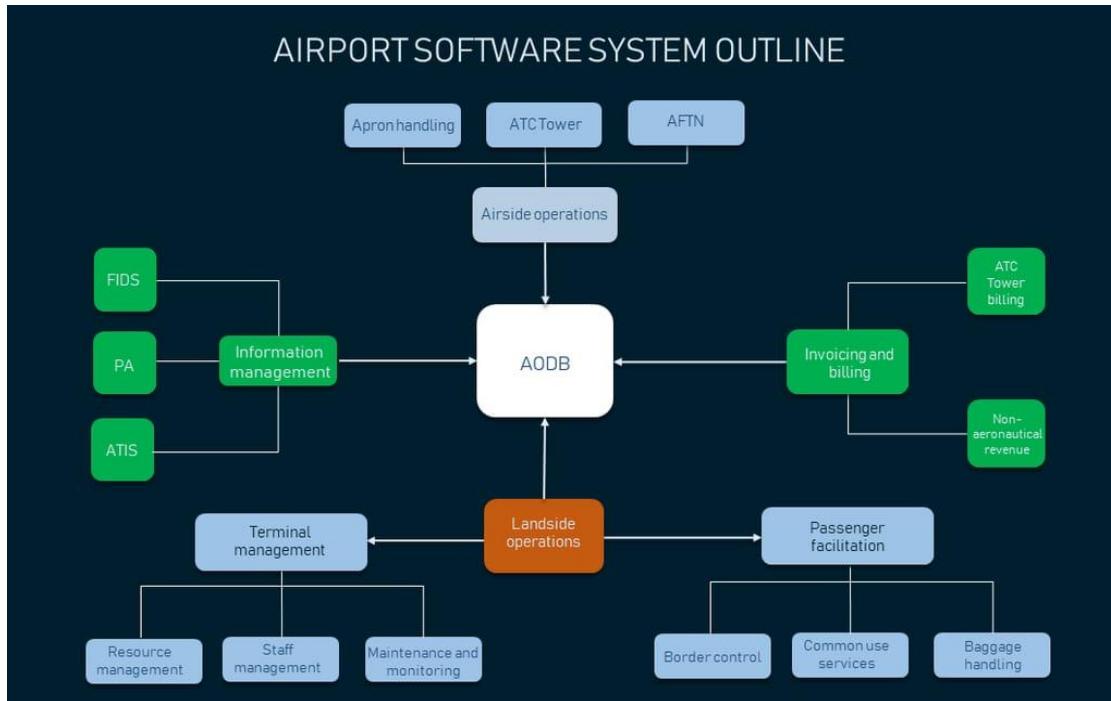


Figure 1.3: Airport software system outline (Source: Alexsoft)

Airport information systems are based on four essential operational processes: landside operations, airside operations, billing and invoicing, and information management. Each of these operations plays a critical role in ensuring smooth airport functioning such as:

- Landside operations are aimed at serving passengers and maintenance of terminal buildings, parking facilities, and vehicular traffic circular drives. Passenger operations include baggage handling and tagging. Terminal operations comprise resource allocation and staff management.
- Airside operations include aircraft landing and navigation, airport traffic management, runway management, and ground handling safety.
- Billing and invoicing operations cover aeronautical and non-aeronautical revenue. Ledger or accounting systems contain information regarding airport finances: flight bills, handling invoices, cash, sales within the airport (points-of-sales), staff payrolls, etc.

- Information management relates to the collection and distribution of daily flight information, storing of seasonal and arrival/departure information, as well as the connection with airlines.

For the scope of this project, we will focus specifically on landside operation, billing and invoicing operation, as these are the two areas that directly impact customer experiences and interactions during air travel. Below, we will provide a detailed breakdown of the systems involved in these operations.

1.3.1 Landside operation

Landside operations focus on processes that take place before passengers go through security. These operations include managing terminal facilities, parking, and vehicular traffic. In terms of passenger facilitation, the systems handle key tasks such as check-in, customs, and baggage handling. Additionally, airport management systems integrate passenger data into border control, allowing authorities to verify passengers in real time. Some key services include:

- **Passenger processing:** This includes automated systems for check-in, boarding, and baggage tagging. Self-service kiosks and mobile apps allow passengers to check in quickly and efficiently, reducing the need for manual intervention.
- **Baggage handling:** This system monitors baggage from the moment it is tagged and checked until it is retrieved at the destination. It ensures timely and accurate handling of luggage, which is critical for maintaining a smooth passenger experience.
- **Customs and border control:** Integrated systems allow airport staff and border officers to cross-check passenger information with government databases, ensuring compliance with security protocols. Biometric systems streamline the identity verification process.

1.3.2 Invoicing and operation

The billing and invoicing systems manage financial transactions for both aeronautical and non-aeronautical services. Each flight generates revenue for the airport through

payments made by the airline. These payments are processed based on aircraft type, weight, parking time, and ground services.

- **Aeronautical revenue:** The system calculates fees based on key data such as aircraft registration, parking time, and flight paths. Invoices are then automatically generated and sent to the airlines for payment, streamlining the payment process and reducing manual work.
- **Non-aeronautical revenue:** Airports also generate revenue from services such as parking, retail sales, and lounge access. The system manages these transactions, integrating data from various points of sale within the airport to maintain accurate financial records.

1.3.3 Vietnam Airlines integrates PSS and XPP technologies to enhance their operational efficiency



Figure 1.4: Logo Amadeus (Source: Amadeus)

In June 2024, Vietnam Airlines successfully integrated the Amadeus Altea PSS (Passenger Service System) into its landside operations, streamlining passenger management processes such as check-in, baggage handling, and passenger data management. Amadeus' Altéa PSS offers Vietnam Airlines comprehensive inventory, reservation, ticketing, departure control and digital solutions for end-to-end efficiencies, to enhance user experience. Altéa PSS also enables Vietnam Airlines to deliver modern, efficient reservation services for front-line employees to aid passengers in purchasing, changing and using services from the airline. This system also equips Vietnam Airlines with best-in-class technology capabilities in aviation and tourism, thereby helping to improve operational efficiency.

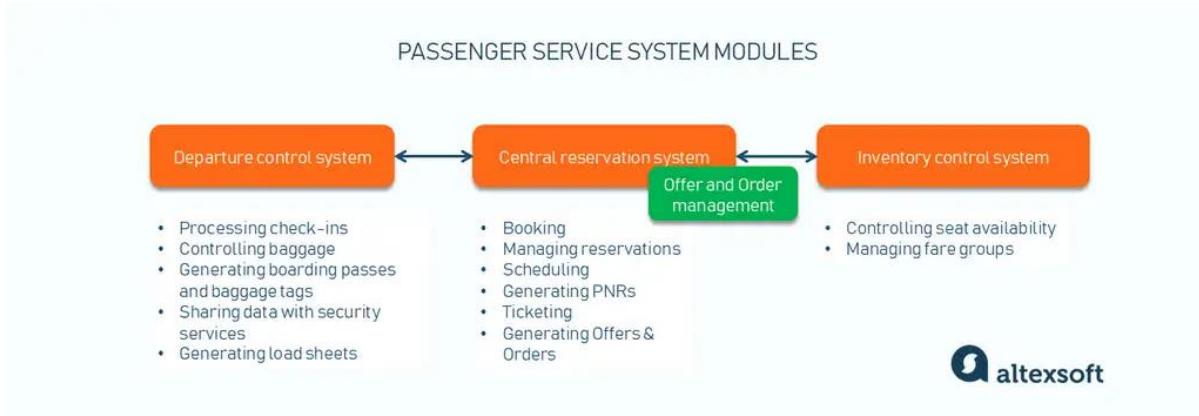


Figure 1.5: Passenger service system modules (Source: Alexsoft)

About the PSS, it is a suite of software modules supporting interactions between the carrier and its customers. Its key components are a central or airline reservation system (CRS), an inventory control system (ICS), and a departure control system (DCS.) The PSS also comprises or integrates with a revenue management tool that analyzes historical data and sets pricing rules and an e-commerce platform (airline website) for flight and ancillary distribution.

For billing and invoicing operations, the airline has implemented the Xchange Payment Platform (XPP) from Outpayce, Amadeus' payments business. This platform allows Vietnam Airlines to easily accept a wide range of card and alternative payment methods from travelers. With XPP, the carrier can accept payments globally, by connecting to a wide range of specialist partners.

Xchange Payment Platform

Our platform sits at the heart of our travel payments technology, designed to optimize payments and provide a single platform through which our customers can manage their entire strategy.

[Contact us](#)



Figure 1.6: Outpayce website (Source: Outpayce)

1.4 Business problems statement

1.4.1 Flight delays and customer satisfaction

One of the pressing issues that Vietnam Airlines faces is the inability to effectively manage flight delays in a way that minimizes passenger dissatisfaction. When a flight is unexpectedly delayed, the current system does not provide a seamless solution for reassigning passengers to alternative flights. As a result, passengers often have to wait long hours at the airport without clear or timely reallocation options. This problem is particularly pronounced for premium passengers who expect a higher level of service and efficiency. Vietnam Airlines needs a more advanced system that not only finds available seats on other flights but also prioritizes passengers based on their class of service (for example, business class over economy). Additionally, the airline seeks to enhance its mobile platform by introducing new features that provide compensation for delayed flights. The updated app will notify passengers of available compensations, offering vouchers or discounts based on the duration of the delay. This will not only address the inconvenience caused by delays but also improve customer experience by offering immediate compensation through the mobile platform.

1.4.2 Airport navigation challenges

Another major issue is airport navigation. With large international airports becoming increasingly complex due to the number of airlines and gates, passengers often face difficulties in finding their check-in counters and departure gates. This problem is especially critical for elderly passengers, non-English speakers, and those who are unfamiliar with the airport layout. The lack of clear and accessible guidance contributes to stress and delays during the boarding process. Vietnam Airlines needs to offer a solution that will assist these passengers in navigating the airport efficiently and in their preferred language.

1.5 Propose solutions

1.5.1 Customer compensation with vouchers

To improve customer experience during delays, Vietnam Airlines will enhance its mobile app to notify passengers of available compensations and vouchers based on the delay duration. The app will automatically offer a selection of vouchers for affected passengers to choose from, providing flexibility and addressing their preferences. These vouchers could include discounts on future flights, food and beverage options, or lounge access. This feature would boost customer satisfaction by acknowledging the inconvenience in real-time and offering immediate, accessible compensations.

1.5.2 Personalized navigation map

To solve the issue of difficult airport navigation, Vietnam Airlines could develop a Personalized Navigation Map feature. This tool, accessible via the airline's mobile app or airport kiosks, would provide passengers with a personalized map of the airport based on their boarding pass information. The map would display the most efficient route from the passenger's current location to their check-in counter, security checkpoint, and departure gate, significantly reducing confusion and stress. The map would also include real-time updates about gate changes and estimated walking times. Key features of the navigation map could include:

- **Multilingual support:** Offering instructions in various languages, catering to non-English speaking passengers.
- **Accessibility options:** Providing simplified instructions for elderly passengers or those with mobility challenges.
- **Integration with real-time flight information:** Updating the map based on current flight status and gate changes to ensure passengers always have the most accurate information.

By integrating this feature with PSS and airport management systems, the airline can enhance the overall airport experience, ensuring that passengers, especially first-time

travelers or those unfamiliar with the airport can navigate the complex environment easily and efficiently.

1.6 Business case

A business case is an important document in project management, especially in businesses. It is a comprehensive report containing information related to the project, covering financial, technical, solution, risk, and business benefit factors. Business case plays a crucial role in project management and businesses because it helps assessing the project's feasibility from various perspectives. By examining financial, technical, solution, risk, and business benefit factors, it assists in determining whether the project can be successfully executed and if it is a worthwhile investment.

Table 1.1: A project business case for mobile app enhancement in Vietnam Airlines

PROJECT BUSINESS CASE			
Business problems	Vietnam Airlines Airport is looking for an enhancement for its mobile platform by introducing new features. If the flight is delayed, the updated app will provide passengers with discount vouchers based on the duration of the delay. Additionally, it will provide GPS functionality to help passengers locate their gates more easily if they encounter any difficulties.		
Project name	Vietnam Airlines mobile app enhancement.		
Project Sponsor	Vinh Dang Tieu	Project manager	Tai Le Nguyen Minh
Date of project approval	2024/10/10	Last revision date	2024/11/23
Contribution to Business strategy	Aligns with Vietnam Airlines' goal of enhancing passenger experience and operational efficiency.		
Options considered	Develop the new features in-house with the current app development team or outsource the development of the new features to an external mobile app development firm.		

	Integrate third-party GPS services but internally develop the discount voucher functionality or use third-parties for both.		
Benefits	<p>Increase customer satisfaction due to suitable compensation for delays.</p> <p>Reduce passenger frustration with gate location assistance.</p> <p>Higher app engagement and user retention.</p>		
Timescales	5 to 6 months (development and testing).		
Costs	<p>Developers: 1500 USD each</p> <p>Project Manager: 2000 USD..</p> <p>UI/UX Designers: 1200 USD each.</p> <p>Marketing team: 1000 USD each.</p> <p>Other IT specialists: 2000 to 3000 USD each.</p>		
Expected return on investment	The investment is expected to be recouped within 18-24 months through increased passenger loyalty and potential partnerships with vendors offering discounts.		
Risks	<p>Potential technical and cost challenges in real-time GPS integration.</p> <p>Customer dissatisfaction if vouchers are perceived as inadequate compensation for delays.</p>		
Business objectives	Goals	Objectives	Action plans
	To enhance the Vietnam Airlines mobile platform to improve customer experience.	Integrate the new features including the GPS tracking and discount vouchers for delayed flights into the existing app infrastructure.	<ol style="list-style-type: none"> Define technical specifications and requirements. Develop GPS and discount voucher features. Test the updated app. Launch the updated app,

			promote it through marketing channels.
Business questions	<p>How will the passengers react to the new features?</p> <p>Will the voucher system be scalable based on different levels of delay?</p> <p>How will real-time GPS data integration impact app performance?</p>		

1.7 Project charter

The project charter is a document that includes information related to the project, such as budget, approvers, timeline, and more. The Project Charter is used by multiple stakeholders to collectively assess the project, and it is ultimately approved by the sponsor. During the course of the project, the Project Charter serves as a guiding principle, allowing all parties involved to rely on it to complete their tasks in the best possible way.

A. General Information:

Project Title:	Vietnam Airlines mobile app enhancement		
Brief Project Description:	This project aims to add more functions into the current system which meets the customers' requirements.		
Prepared By:	Group 3		
Date:	2024/10/10	Version:	First

B. Project Objective:

The main objective of this project is to enhance the customers' satisfaction by adding two functions into the old system. The future system can provide clear guidance for passengers from the time they go to the airport to having a seat on the aircraft. In addition, in case of delays, the airline can proactively handle difficult customers by providing them the suitable combos, vouchers, or other options. When it comes to the system, we have a visual map for customers when they can not find their check-in counter, gates, v.v. By evaluating the airline's resources and based rules, the application provides the customers with delayed flights options to satisfy them.

C. Assumptions

1. All members must be ready to work through a complete project and there are not any members leaving when the project starts . This will be checked by the leader.
2. The budget needs to be fully allocated quarterly and the adjustments do not exceed the threshold. The financial department approves and follows the flow of budget through a complete project.
3. All necessary approvals will be completed within five business days of submission to avoid any delays in the project schedule. The project manager will coordinate with stakeholders to ensure timely processing of approvals.
4. The project scope and requirements will remain stable throughout the project, with no significant changes being introduced after the start date. Any proposed changes will be thoroughly reviewed and controlled by the project manager to minimize impacts on time and cost.
5. External factors such as legal, economic, or environmental conditions will remain unchanged during the project timeline. The legal and risk management teams will monitor these factors closely to ensure no unexpected disruptions occur.

D. Project Scope

Describe the scope of the project. The project scope establishes the boundaries of the project. It identifies the limits of the project and defines the deliverables.

The project will be carried out exclusively by the Organizational - Administrative Department, the Accounting Department, and the Infrastructure Operations Management Center. The project is expected to be completed within 45 days from the initial approval date. The budget allocated for the project is \$10,000. The development team will need access to the map data of the airports operated by Vietnam Airlines, as well as partial access to the partner airports of Vietnam Airlines.

List any requirements that are specifically excluded from the scope.

Deliverables for each milestone must not be delayed by more than 2 days beyond the deadline. Budget variance must not exceed \$1,000 from the allocated budget. No additional features beyond the two specified functions will be proposed. Training employees to use the app and marketing activities for the new system will be excluded from the project scope.

List the major milestones and deliverables of the project.

Milestones	Deliverables	Date
Project approval	Approved project charter and budget allocation.	2024/10/12
Collecting required map data	Map data.	2024/10/20
Completion of App Design	Finalized app interface design.	2024/11/10
Map Integration	Fully integrated airport map feature with user navigation support.	2024/11/13
Delay Options Implementation	Feature allowing customers to choose support options during flight delays.	2024/11/16
Testing and QA	Completed user acceptance testing and bug fixes.	2024/11/20
Final Deployment	Fully deployed app ready for use, within specified budget and timeline.	2024/11/23

List the impact this project may have on existing systems or units.

Systems / Units Impacted	Potential Impact
Flight Management System	May require adjustments to integrate new information from the application.

Customer Service Department	Staff may need training to use the new application and handle customer requests.
Marketing Department	May need to adjust communication strategies to promote the new features of the application.
Airport Map Database	Requires access to and integration of map data, which may affect data retrieval performance.
Compliance and Risk Management	Needs to review the application for compliance with industry regulations and data privacy standards.

E. Roles and Responsibilities

Sponsor: Provides overall direction on the project. Responsibilities include: approving the project charter and plan; securing resources for the project; confirming the project's goals and objectives; keeping abreast of major project activities; making decisions on escalated issues; and assisting in the resolution of roadblocks.

Name	Email / Phone
Vinh Dang Tieu	vinhtd22416c@st.uel.edu.vn

Project Manager: Leads in the planning and development of the project; manages the project to scope. Responsibilities include: developing the project plan; identifying project deliverables; identifying risks and developing a risk management plan; directing the project resources (team members); scope control and change management; overseeing quality assurance of the project management process; maintaining all documentation including the project plan; report and forecast project status; resolve conflicts within the project or between cross-functional teams; ensure that the project's product meets the business objectives; and communicate project status to stakeholders.

Name	Email / Phone
Tai Le Nguyen Minh	tailnm22410c@st.uel.edu.vn

Team Member: Works toward the deliverables of the project. Responsibilities include: understanding the work to be completed; completing research, data gathering,

analysis, and documentation as outlined in the project plan; informing the project manager of issues, scope changes, and risk and quality concerns; proactively communicating status; and managing expectations.

Name	Email / Phone
Anh Le Pham Quynh	anhlpq22416c@st.uel.edu.vn
Khanh Vu Quoc	khanhvq22416c@st.uel.edu.vn

Customer: The person or department requesting the deliverable. Responsibilities include partnering with the sponsor or project manager to create the Project Charter; partnering with the project manager to manage the project including the timeline, work plan, testing, resources, training, and documentation of procedures; working with the project team to identify the technical approach to be used and the deliverables to be furnished at the completion of the project; provide a clear definition of the business objective; sign-off on project deliverables; take ownership of the developed process and software.

Name	Email / Phone
Tien Le Minh	tienlm22416c@st.uel.edu.vn

Subject Matter Expert: Provides expertise on a specific subject. Responsibilities include: maintaining up-to-date experience and knowledge on the subject matter; and providing advice on what is critical to the performance of a project task and what are nice-to-know insights.

Name	Email / Phone
Thanh Ho Trung	thanhht@uel.edu.vn

F. Resources

Identify the initial funding, personnel, and other resources committed to this project by the project sponsor.

Resource	Constraints
Project Budget	The project budget is capped at \$5,000, with no room for extra funding or significant overages.

Personnel	The team size is fixed, including 5 staff.
Data Access	Access is limited to the airport maps where Vietnam Airlines operates and partial access to its partner airports.
Time	The project must be completed within 45 days from approval, with no extension allowed.
Infrastructure	Existing infrastructure will be used without any new equipment or upgrades.

G. Project Risks

Identify the high-level project risks and the strategies to mitigate them.

Project Risks	Mitigation Strategies
Budget Overruns	Establish strict budget tracking and implement approval processes for any expenditure over \$1,000.
Data Access Limitations	Secure early agreements with partner airports for access to necessary data.
Personnel Availability	Ensure commitment from key team members and establish a backup plan for critical roles.
Delay in Project Schedule	Set intermediate milestones with frequent progress reviews to identify delays early.
Technical Integration Challenges	Allocate additional time for testing and collaborate with IT teams to troubleshoot integration issues.
Regulatory Compliance Issues	Consult with legal and regulatory teams early to ensure all aspects comply with industry standards.

H. Signatures

The signatures of the people below document approval of the formal project charter. The project manager is empowered by this charter to proceed with the project as outlined in the charter.

Customer:		
Name	Signature	Date
Tien Le Minh		
Project Sponsors:		
Name	Signature	Date
Vinh Dang Tieu		
Project Manager:		
Name	Signature	Date
Tai Le Nguyen Minh		

1.8 Assumptions

User Assumptions:

All users are expected to use a smartphone with a 4G/5G network connection and to enable the GPS location service while having a basic understanding of using smartphones or tablets. Users are assumed to have already installed and used the Vietnam Airlines application. Furthermore, their application login accounts are registered using a Gmail account or a personal phone number.

Technology Assumptions:

Vietnam Airlines' infrastructure is assumed to be capable of storing and handling a large volume of devices accessing GPS data with low latency. The Vietnam Airlines application supports high-precision GPS tracking and has the ability to provide airport information (such as boarding gates and boarding times). The application is also expected to be capable of calculating vouchers for customers based on flight delay times. Vietnam Airlines has a robust database system to ensure the security of customer data.

Operational Process Assumptions:

The changes mentioned will only serve as enhancements and will not affect the current operational procedures of the airline. Employees are trained to assist customers with issues related to accounts, connectivity and GPS. Users will be notified when the Vietnam Airlines application is updated.

Rights and Security Assumptions:

All users are assumed to accept the terms and conditions when using the Vietnam Airlines application, including permissions from screen notifications to accessing the device's location. The new features implemented in the application are expected to be well-received by users, with no significant obstacles and are to be rolled out according to a predefined schedule.

1.9 System impacted

Vietnam Airlines Mobile Application: The application is being updated to add GPS location features and voucher calculations based on the passengers' flight delay times. The application also enhances user interaction by integrating real-time maps of boarding gate locations and boarding times. When these changes are implemented, users will need to update the existing Vietnam Airlines app on their device or install the latest version.

Vietnam Airlines Database and Security System: The database of Vietnam Airlines needs to be expanded to support a large volume of information from GPS and customer vouchers. Additionally, the database system must be robust enough to ensure the security of customer information. The security system will also be upgraded to protect user information, application usage history and travel history while utilizing the new features mentioned above.

Operational Process and Customer Support: Employees must receive additional training to address issues related to the new application features, including connectivity services (network, GPS) and vouchers. The current support process must be adjusted to align with the new model, ensuring that customers receive timely, efficient and effective assistance.

User Experience: The application's interface will undergo minor changes to incorporate the functions of GPS services and vouchers. Users will receive notifications about the new updates to the application, allowing them to easily access and fully utilize all the latest features.

1.10 Introduction to the project SDLC methodology

To ensure that the application is controlled and developed in a clear and systematic manner, the team has chosen the SDLC methodology following the Waterfall model. Each phase in this model must be completed before moving on to the next, ensuring clarity and transparency for the project while also helping to allocate resources more effectively.

There are 7 key steps in the SDLC methodology: Requirement Analysis, Planning, Designing, Development, Testing, Deployment, and Maintenance.

The 7-step process is carried out as follows:

Requirement Analysis: The team gathers and analyzes the requirements from Vietnam Airlines and its application users. The main requirements include: the feature to automatically calculate and issue vouchers for passengers when flights are delayed, along with the GPS functionality to help passengers easily locate their boarding gates. The result of this phase is a detailed document describing both the functional and non-functional requirements of the system.

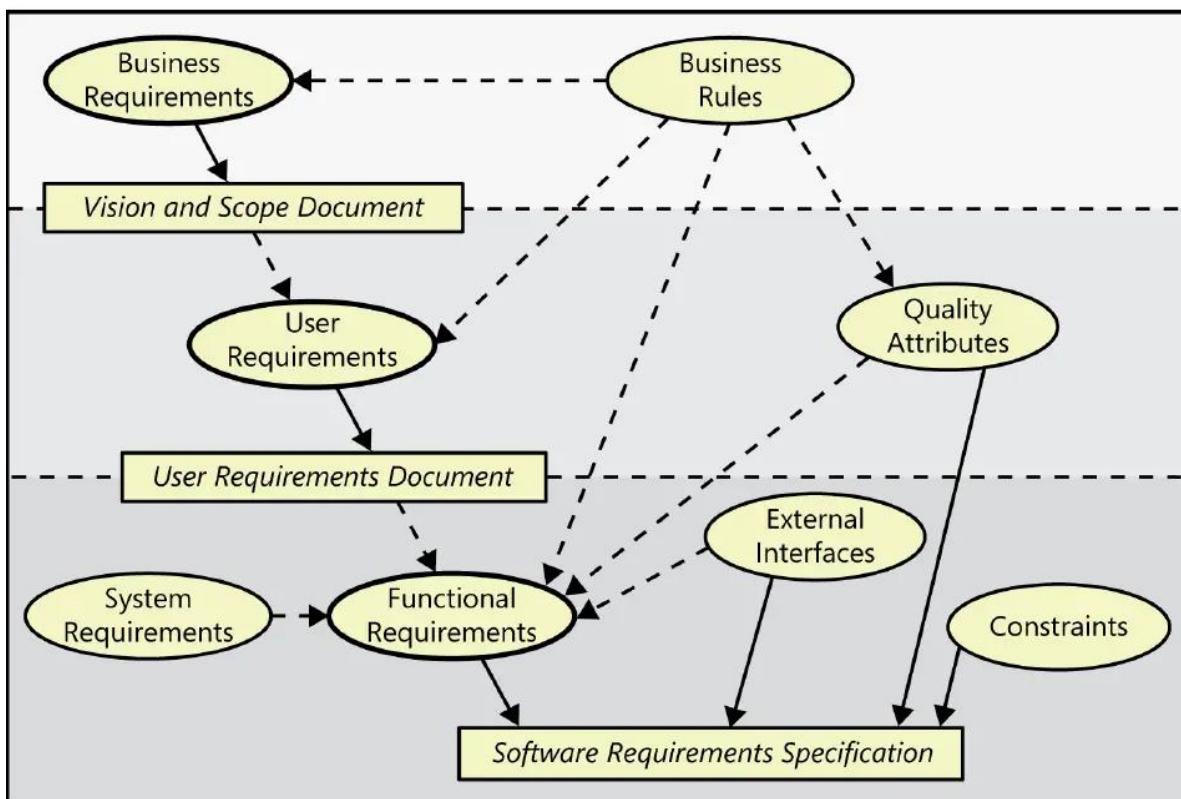


Figure 1.7: Models the relationships between several types of required information. (Source: Software Requirements by Karl Wiegers Joy Beatty)

Planning: After completing the requirement gathering and analysis, the next step is to create a detailed project plan. This plan includes identifying necessary resources, allocating resources (personnel, time, budget), and setting timelines for each phase of the project. The plan also covers potential risks during development and strategies to mitigate them. The result of this phase is a detailed project plan that helps guide and monitor the development process.

Designing: In this phase, the team will create a detailed design for the system, including both the user interface design and the technical design (system architecture, database design). The GPS functionality and the voucher issuance system will be carefully planned to ensure the system's logic. The design serves as the foundation for the team to proceed with coding the system.

Development: In this phase, the team begins coding and developing the application based on the previously established design. New features like GPS functionality and the voucher issuance system will be integrated into the existing Vietnam Airlines application. Software modules are developed and tested independently before being integrated into the overall system.

Testing: Once development is complete, the team will thoroughly test the entire system to ensure that all features function as expected. Testing will include unit testing, integration testing, and system testing. After that, User Acceptance Testing (UAT) will be conducted with actual users to ensure that the system meets their needs and requirements.

Deployment: After rigorous testing, the application will be deployed in the live environment. Users will be required to update the Vietnam Airlines application to the latest version in order to use the new features. The deployment process must ensure that the system operates smoothly on both Android and iOS platforms.

Maintenance: After the application is launched, continuous system maintenance will take place. This includes fixing bugs, updating new features, and improving the system based on user feedback. The maintenance process also ensures that the system continues to operate smoothly and is ready for future changes.

Part 2. Fact-finding and Requirements modeling

2.1 Introduction to techniques applied for Fact-finding and Requirements modeling

In order to develop a comprehensive and effective enhancement for Vietnam Airlines' mobile platform, fact-finding and requirements modeling are critical steps. These processes involve gathering accurate data about user needs, system functionalities, and operational goals to ensure the application upgrade aligns with user expectations and business objectives. Below are the techniques applied for fact-finding and requirements modeling in the context of Vietnam Airlines' app enhancements.

2.1.1 Techniques applied for Fact-finding

Fact-finding refers to methods used to gather data and understand the current situation of both the system and the stakeholders. In this case, it involves gathering information related to passengers' experiences with delayed flights, compensation methods, and navigating airport gates. The following techniques will be employed:

Interviews: Interviews with key stakeholders, including passengers, airport staff, and airline management, will be conducted to understand the specific needs and pain points. Through structured and semi-structured interviews, Vietnam Airlines can obtain qualitative insights on how users interact with the existing app and what enhancements they would like to see. These interviews will focus on the history of flight delays that customers have experienced and the compensation they desire, the challenges and difficulties customers have in finding check-in gates within the airport, and provide feedback on current app functionality and areas for improvement.

Surveys and Questionnaires: To gather a larger volume of data, surveys and questionnaires will be distributed to passengers who frequently use Vietnam Airlines' app. These tools will collect both quantitative and qualitative feedback on passengers' experiences with flight delays and the usability of the current gate navigation feature. The key focus areas of the survey include the frequency of flight delays encountered, satisfaction with the current compensation measures, ease of locating gates at various airports, and opinions on potential app enhancements, such as improved GPS functionality.

Document Analysis: Existing documents, such as flight delay compensation policies, customer feedback reports, and app usage statistics, will be reviewed. This technique will

provide context on current compensation practices and how frequently passengers face delays. Document analysis will also help identify common customer complaints about the current system, guiding the requirements gathering process.

Observation: Direct observation of passenger behavior during flight delays and while navigating the airport will be conducted. This includes monitoring how passengers interact with the mobile app, how they find information related to gate locations, and their responses to compensation offers during delays. Observation helps identify usability challenges and validates insights obtained through interviews and surveys.

Prototyping: Building a low-fidelity prototype of the enhanced mobile app can serve as a practical tool for fact-finding. By allowing users to interact with a prototype featuring delay compensation and GPS gate navigation, we can gather feedback on user experience and identify any gaps in functionality before full-scale development begins.

2.1.2 Techniques applied for Requirements modeling

In the process of enhancing Vietnam Airlines' mobile platform, effective requirements modeling is essential for identifying, documenting, and refining the specific needs of stakeholders such as passengers, airline staff, and management. The goal is to ensure that the platform not only meets functional needs, such as compensation for flight delays, but also enhances the user experience, particularly with features like GPS-based gate navigation. To achieve this, several team-based techniques are applied, focusing on collaboration, flexibility, and continuous feedback. The key techniques used for this project include Joint Application Development (JAD), Rapid Application Development (RAD), and the Agile Methodology. Each of these techniques plays a pivotal role in gathering requirements, ensuring user involvement, and allowing iterative development for the mobile platform.

Joint Application Development (JAD): Joint Application Development (JAD) is a highly structured and collaborative technique employed to gather requirements by bringing together key stakeholders, including end users, developers, business analysts, and subject matter experts, into a series of workshops. The primary objective of JAD is to expedite the decision-making process, enhance communication among stakeholders, and

produce a comprehensive set of system requirements that accurately reflect user needs and business goals. By fostering collaboration, JAD ensures that all relevant perspectives are considered during the requirements gathering phase.

One of the key features of JAD is stakeholder collaboration. JAD workshops are meticulously designed to involve all relevant parties in the decision-making process. For the Vietnam Airlines project, stakeholders might include frequent passengers, airline management, customer service representatives, IT professionals, and airport staff. This direct involvement guarantees that each group's needs and concerns are adequately addressed, ensuring a holistic understanding of the requirements.

Another important aspect of JAD is the structured workshops that follow a predefined agenda. During these workshops, stakeholders engage in discussions about specific topics, such as compensations for flight delays, the app's ease of use, and additional features like GPS-based gate navigation. Facilitators guide the discussions to ensure that all pertinent issues are addressed in a timely manner, maintaining focus and productivity throughout the sessions.

A significant advantage of JAD is its capacity for real-time feedback. This allows participants to collect insights and opinions as discussions unfold. For instance, if passengers express concerns regarding compensation for flight delays, potential solutions can be discussed and refined immediately. This feedback loop enhances the quality of the requirements gathered, as stakeholders can clarify and adjust their needs on the spots. In terms of application, JAD sessions for the Vietnam Airlines mobile app will focus on several key areas. First, they will identify major pain points for passengers, such as challenges in navigating airport gates or the complexities of the compensation process for delayed flights. Additionally, these sessions will gather input from staff and management on how to streamline internal processes, including communication with passengers during flight delays. Finally, as each requirement is proposed, participants in the JAD workshop will validate its relevance and feasibility based on their collective expertise, ensuring that the requirements are practical and aligned with business objectives.

The benefits of JAD are manifold. First, it leads to improved communication by reducing the risk of miscommunication between developers and stakeholders, as real-time

discussions allow for clarification and immediate resolution of issues. Additionally, JAD enhances speed and efficiency; by having all stakeholders in the same room, decisions are made more quickly, thereby reducing the time spent on requirements gathering. Ultimately, the comprehensive nature of JAD means that the final set of requirements is more likely to accurately reflect the true needs of the business and its users, resulting in a mobile app that effectively serves the needs of passengers and enhances their travel experience.

Rapid Application Development (RAD): RAD is a software development approach that emphasizes quickly building prototypes and iterating based on user feedback. By focusing on speed and adaptability, RAD allows for the rapid delivery of functional systems while incorporating stakeholder feedback throughout the development process. In the context of requirements modeling for Vietnam Airlines, RAD facilitates the swift creation of a working model of the mobile app, which can be used to gather additional requirements as stakeholders engage with it.

A key feature of RAD is **prototyping**. This involves developing early versions of the system to visualize key functionalities. For the Vietnam Airlines project, prototypes of critical features, such as the flight delay compensation mechanism and the GPS-based gate navigation tool, can be constructed early in the development cycle. These prototypes serve as tangible representations of the app's capabilities, allowing stakeholders to assess and provide feedback on their functionality and usability.

Iterative development is another essential aspect of RAD. As stakeholders interact with the prototypes, they offer insights into usability and feature performance. This feedback is then utilized to enhance the prototype in iterative cycles, refining the product until it meets the established requirements. This iterative approach not only helps in identifying problems early on but also ensures that the evolving app aligns closely with user expectations and needs.

User involvement is crucial throughout the RAD process. Frequent passengers and airport staff are continuously engaged, providing valuable insights into how the system should operate to effectively meet their needs. This ongoing collaboration ensures that the development remains user-centered and relevant to the actual users of the app.

In applying RAD to the Vietnam Airlines project, the team will focus on developing a prototype of the mobile app that incorporates the new compensation and GPS features within a short time frame. This prototype will be presented to stakeholders, including passengers, staff, and management, to gather feedback. Based on this input, the prototype will be refined, ensuring that features such as compensation levels for delays and ease of gate navigation align with user expectations.

The benefits of RAD are significant. First, it allows for a **quick turnaround**, enabling the delivery of a working system for stakeholders to test, which allows for early identification and resolution of issues in the development process. Additionally, the user-centered nature of RAD ensures that the final system closely aligns with user needs. Finally, RAD offers **flexibility**; changes can be easily incorporated based on user feedback, which helps to prevent costly rework later in the project.

Agile Methodology: Agile is an iterative and incremental software development approach that prioritizes collaboration, flexibility, and continuous improvement. By breaking projects into smaller, manageable increments known as **sprints**, Agile teams work to develop features within short timeframes. After each sprint, feedback is gathered from stakeholders, and the priorities for the next sprint are adjusted accordingly. This methodology is particularly effective in dynamic environments where requirements may evolve throughout the project lifecycle.

A fundamental feature of Agile is the use of **sprints**. Agile projects are divided into sprints that typically last between 1 to 4 weeks. Each sprint concentrates on delivering a specific set of features. In the context of Vietnam Airlines, initial sprints may focus on developing the flight delay compensation module, while subsequent sprints might target the GPS-based gate navigation system.

Frequent feedback is integral to the Agile process. At the conclusion of each sprint, a functional version of the product is delivered to stakeholders, allowing for the collection of feedback from passengers and airline staff. This input is crucial for informing adjustments in the next sprint, ensuring that any new requirements or changes are addressed promptly.

Collaboration is another key aspect of Agile. The methodology fosters close cooperation among all team members, including developers, testers, business analysts, and stakeholders. This collaboration ensures that requirements are clearly understood and accurately implemented, reducing the likelihood of misunderstandings and errors.

For Vietnam Airlines, the Agile methodology will be applied by breaking the project into sprints, each concentrating on specific features, such as the compensation structure or GPS navigation. Incremental versions of the mobile app will be delivered for user testing and feedback after each sprint. Feedback gathered will be incorporated into subsequent sprints, ensuring that the app evolves to meet user expectations throughout its development.

The benefits of Agile are manifold. Its **adaptability** allows the team to quickly respond to changes in requirements as the project progresses, making it easier to pivot when necessary. Additionally, Agile promotes **continuous improvement**; by collecting feedback at the end of each sprint, the product is consistently refined to align with stakeholder expectations. Finally, Agile's iterative approach reduces the risk of developing features that do not meet user needs, as regular testing and feedback cycles help identify issues early in the development process. This ultimately leads to a more effective and user-friendly mobile platform for Vietnam Airlines.

In conclusion, using team-based techniques like JAD, RAD, and Agile for requirements modeling ensures that the enhanced Vietnam Airlines mobile platform is developed in a collaborative, flexible, and user-centered manner. JAD facilitates real-time collaboration and decision-making among stakeholders, RAD accelerates prototyping and iterative feedback, and Agile enables the project team to adapt to evolving requirements while ensuring continuous delivery of value. Together, these methods provide a comprehensive approach to ensuring that the final product meets the needs of passengers, staff, and management effectively.

2.2 Deliverables

In the context of enhancing Vietnam Airlines' mobile platform, the deliverables outlined below will encapsulate the outputs from the fact-finding and requirements modeling processes. Each deliverable will play a critical role in guiding the development team, informing stakeholders, and ensuring that the final mobile app meets user needs and business objectives.

Table 2.1: Deliverables overview for Vietnam Airlines mobile app enhancements

Deliverables	Description	Purpose
Stakeholder Analysis Report	A comprehensive report detailing key stakeholders, including passengers, airport staff, and management, along with their needs, pain points, and expectations from the mobile app enhancements.	To ensure all relevant perspectives are considered in the development process, fostering a user-centered approach.
Fact-Finding Summary	A synthesis of data gathered through interviews, surveys, observations, and document analysis. This summary will highlight key insights related to passenger experiences, compensation preferences, and navigation challenges within the airport.	To provide a clear understanding of the current issues and opportunities for improvement, forming a foundation for requirements gathering.
Requirements Specification Document	A detailed document outlining the functional and non-functional requirements for the mobile app enhancements. This will include features such as flight delay compensation mechanisms, GPS-	To serve as a clear guideline for developers, ensuring all stakeholders' needs are documented and agreed upon.

	based gate navigation, and user interface specifications.	
Prototyping Feedback Report	A report capturing feedback gathered from stakeholders during the prototyping phase. This will include insights on usability, functionality, and areas for refinement based on stakeholder interactions with the prototype.	To identify gaps in functionality and user experience early in the development process, ensuring the final product aligns with user expectations.
Risk Assessment Report	A report identifying potential risks associated with the mobile app enhancement project, along with mitigation strategies. This will include technical risks, user adoption risks, and any operational challenges.	To proactively address potential obstacles, ensuring that the project team is prepared to manage risks effectively throughout the development process.
Final Presentation for Stakeholders	A comprehensive presentation summarizing the findings from fact-finding activities, the proposed requirements, and the development plan for the mobile app enhancements. This will include visuals from prototypes and an overview of the Agile sprint approach.	To communicate progress and obtain final buy-in from stakeholders, ensuring that all parties are aligned before full-scale development begins.

The deliverables outlined in this section will provide a robust framework for developing the enhanced mobile platform for Vietnam Airlines. Each deliverable will play a crucial role in ensuring that the application meets user needs while aligning with business

objectives, ultimately enhancing the overall passenger experience. By emphasizing collaboration, user feedback, and iterative development, these deliverables will support the successful implementation of the project.

2.3 Current system and system diagrams (As-is business)

Step 1: Preparation

Passengers need to prepare their plane ticket, citizen ID card, visa, and passport (for international flights).

Step 2: Ticket Purchase

There are two ways to purchase tickets:

- Paper ticket: Buy it at the airport and proceed to the check-in counter.
- Online ticket: Purchase online, declare checked luggage (if any), and check in from home.

Note: Regarding luggage, passengers must not carry prohibited items such as sharp objects, flammable substances, liquids, or chemicals. Luggage is divided into two types:

- Checked luggage
- Cabin luggage

Note: The weight and size of checked luggage are determined by the ticket class and whether the flight is domestic or international.

Example: Checked baggage allowance for domestic flights within Vietnam:

- Business Class: 1 piece, 32kg
- Premium Economy Class: 1 piece, 32kg
- Economy Class: 1 piece, 23kg

If the luggage exceeds the allowed weight or size, passengers will be required to repack or pay an additional fee. Otherwise, the airline may refuse to accept the luggage.

Step 3: Arrival at the Airport (Departure)

Upon arriving at the airport, passengers proceed to the baggage drop area to check in their luggage (if any). Luggage check-in must be completed at least 3 hours before departure. If this deadline is missed, the airline will refuse to accept the checked luggage.

Step 4: Luggage Inspection

Baggage staff will inspect the luggage. If it meets the airline's regulations, the luggage will be accepted. Otherwise, it will be rejected.

Step 5: Check-in (for paper tickets only)

Passengers holding paper tickets must visit the check-in counter to verify their flight ticket and identification documents. This process must be completed between 3 hours and 40 minutes before departure. Each ticket class will have a separate queue line at the check-in area. If there are any discrepancies in the documents, passengers will not be allowed to pass the ticket inspection and must resolve the issue with the airline. If everything is in order, passengers will receive their ticket, personal documents, and boarding pass. For transit flights, the airline will provide boarding passes for all segments of the journey.

Step 6: Security and Customs Procedures

- International Flights: Passengers proceed to immigration control, where they present their visa for customs inspection and stamping.
- Domestic Flights: Passengers undergo security checks and cabin luggage inspection.

At the luggage inspection area, passengers place their cabin luggage on the conveyor belt for scanning. If the cabin luggage exceeds the allowed size or weight, it will need to be checked in. Additionally, passengers are required to remove any metal items from their bodies and undergo full-body scanning for security clearance. After passing these checks, passengers proceed to the waiting lounge.

Note: Passengers typically wait in the lounge for about 30 minutes before being escorted to the aircraft by the ground service team. They either board the plane directly from the lounge or use a dedicated airport shuttle. Passengers must be on board at least 15 minutes before departure; otherwise, the boarding gate will close.

Step 7: Boarding and Flight Departure

Once on the plane, flight attendants will check boarding passes, guide passengers to their seats, and initiate the flight journey.

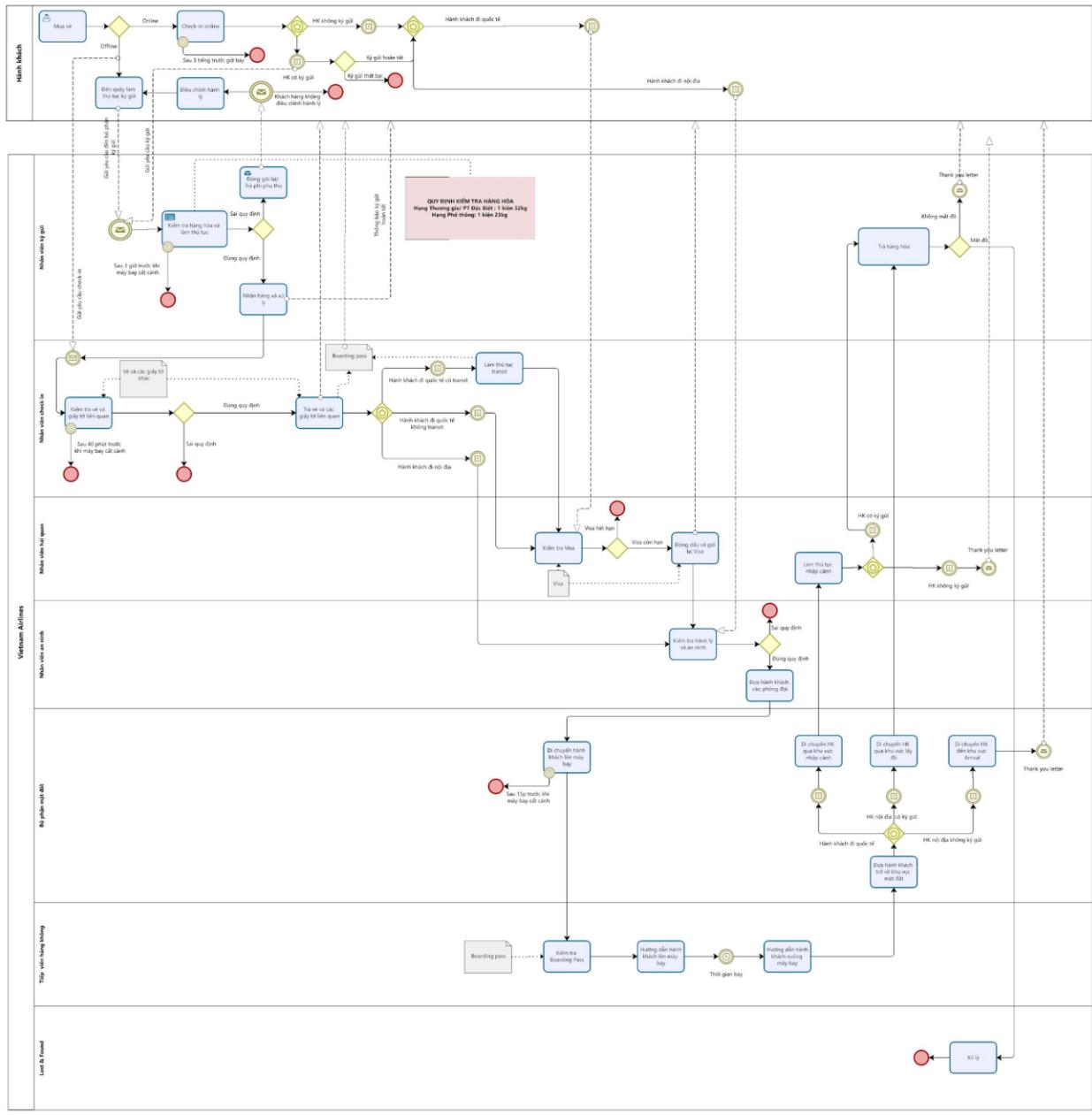


Figure 2.1: Current system diagram of Vietnam Airlines

2.4 Business Requirement Documents

2.4.1 Introduction

Vietnam Airlines aims to improve its mobile platform by rolling out new features to enhance the customer experience, especially in situations of flight delays. The upgraded app will provide compensation in the form of vouchers and GPS navigation support to help passengers find their boarding gates quickly and conveniently.

Table 2.2: Key content of each action

Actions	Key Content
Project Overview	Project Name: Vietnam Airlines Mobile App Enhancement Objectives: Provide automatic compensation through vouchers for delayed flights. Support real-time GPS navigation to locate boarding gates.
Project Scope (In-Scope)	Flight Delay Compensation: Issue vouchers automatically based on the duration of the flight delay. GPS Navigation: Provide GPS-based positioning to assist passengers in locating boarding gates. Service Voucher Integration: Allow vouchers to be used at airport stores and onboard services.
Project Scope (out of scope)	Change the current manual claims process.
Business driver	Improve Customer Experience: Minimize passenger discomfort during flight delays by providing timely compensation. Increase Competitiveness: Attract customers and enhance service value compared to other airlines. Optimize Operations: Assist passengers with easy navigation to avoid missed flights.

System Perspective	Ensure compliance with aviation industry regulations and privacy laws.
Assumptions	Flight data is always accurately updated from the airport system. Vouchers are valid for 24 hours after issuance.
Constraints	Compliance with aviation regulations and security requirements is mandatory. Resource limitations may affect development progress.

2.4.2 Business Process Overview

Current Business Process (As-Is)

- **Flight Delay Notification:**

Vietnam Airlines staff will announce flight delays through airport public announcements.

No automatic compensation; passengers must visit the customer service desk to request compensation.

- **Airport Navigation:**

Passengers find their way to the boarding gate using signs within the airport.

If they encounter difficulties, they must ask airport staff for assistance.

- **No Voucher Management Integration in the App:**

All offers or vouchers must be manually issued at the service desk.

Proposed Business Process (To-Be)

- **Automatic Notification and Compensation:**

When a flight is delayed, the system will immediately send a notification to the passenger's mobile app.

Based on the delay duration, the app will automatically issue vouchers to passengers:

Under 2 hours: Discount voucher for food and beverage stores.

2 to 5 hours: 10% flight discount voucher and free flight change.

Over 5 hours: 20% flight discount voucher, accommodation support, and free flight change.

- **GPS Navigation:**

Passengers can use the GPS feature in the app to locate their boarding gate.

The app will provide real-time directions and send alerts if passengers are at risk of missing their flight.

- **Voucher Management and Usage:**

Vouchers are displayed directly in the passenger's mobile app.

Passengers can redeem the vouchers at airport stores or services.

Free flight change options are automatically activated and displayed when applicable.

- **Benefits of the New Process:**

Time-saving: Passengers no longer need to visit the service desk to receive compensation.

Improved operational efficiency: Reduces pressure on airport staff and enhances the customer experience.

Enhanced navigation: Helps passengers navigate the airport with greater confidence through GPS guidance.

2.5 Systems Requirements Documents

2.5.1 Functional Requirements

A functional requirement is a statement of what a product (system, subsystem, device, or software program) must do. In product development, functional requirements are typically decomposed into more detailed requirements at progressive levels of the design process. Their fulfillment is verified and validated through functional testing (software testing, integration testing, etc.). Functional requirements are always mandatory; they must be met by the product unless the requirement is changed (JAMA Software).

According to Prof. Dr. Nizamettin AYDIN, there are two types of functional requirements:

- Process - Oriented (PO): A process that a system has to perform.
- Information - Oriented (IO): Information that a system has to contain.

In addition, Engineer Alistair Mavin, developer of the Easy Approach to Requirements Syntax (EARS), has identified five requirements archetypes that can be used to craft clear, concise requirement statements that cover practically all functional specification needs. These include Ubiquitous (UB) Requirements, State-driven (SD) Requirements, Event-driven (ED) Requirements, Optional (OP) Requirements, Unwanted Behavior (UN) Requirements, and Complex (CO) Requirements.

Assigning a requirement identifier helps ensure traceability, making it easier to track and manage requirements throughout the system development life cycle, especially in projects adhering to industry standards like **IEEE/EIA 12207**. It is often a contractual requirement to ensure each requirement has a unique identifier (PUI), facilitating verification and validation processes. Accordingly, the PUI column in the table 2.3 is specified as follows: For Process-Oriented Requirements, it will begin with "PO," followed by the code for one of the six requirements according to Mavin, then a function code, which consists of four codes:

0. General
1. Automatic Notification and Compensation
2. GPS Navigation

3. Voucher Management and Usage

and finally, the sequential number according to each type of requirements from Mavin. For Information-Oriented Requirements, it will begin with "IO," followed by a sequential number without division by function.

Table 2.3: Functional requirements

PUI	Description
POED001	When users log in, the system shall validate user credentials.
POED002	When users enter their tickets, the system shall validate the information.
POCO101	When the aircraft has not arrived 15 minutes before departure, if the system can not calculate the delay time, the system shall automatically send a discount voucher for food and beverage stores and a free flight change voucher to the passenger's voucher section.
POED101	When the aircraft has not arrived 15 minutes before departure, the system shall start calculating the delay time.
POOP101	Where the system starts to calculate the delay time, the system shall send the notification to the passengers.
POOP102	Where the delay time is under 2 hours, the system shall automatically send a discount voucher for food and beverage stores to the passenger's voucher section.
POOP103	Where the delay time is between 2 and 5 hours, the system shall automatically send a 10% flight discount voucher and a free flight change voucher to the passenger's voucher section.
POOP104	Where the delay time is above 5 hours, the system shall automatically send a 20% flight discount voucher, an accommodation voucher and a free flight change voucher to the passenger's voucher section.
POUB101	The system shall monitor the location of flights at any time.
POUB201	The system shall monitor the location of passengers at any time.

POCO201	Where tickets are verified, while the passengers have not yet gone to the aircraft, the system shall draw the shortest path on the map.
POUB202	The system shall display the information of all places on the map at any time.
POUB203	The system should allow users to zoom in or out by no more than 50% of the fixed screen.
POED201	If the user clicks on a location on the map, the system should draw an additional route that passes through that location while still maintaining the shortest path.
POUB301	The system shall check the expiry date of all vouchers.
POED301	If a voucher reaches its expiration date, the system shall automatically delete it from the user's voucher section.
POED302	If the user has used the voucher, the system shall automatically delete it from the user's voucher section.
IO01	The system must contain the information of all flights.
IO02	The system must contain maps of the airports that the airline operates.
IO03	The system must contain vouchers from the airline's partners.

2.5.2 Non-Functional Requirements

Non-functional requirements are global constraints on a software system e.g., development costs, operational costs, performance, reliability, maintainability, portability, robustness etc. A requirement that does not relate to functionality, but to attributes such as reliability, efficiency, usability, maintainability, and portability. For this project, Non-functional Requirements are divided into the following types: Performance Requirements (PR), Platform Constraints (PC), Accuracy and Precision (AP), Adaptability (AD), and Security (SC).

The PUI column in the table 2.4 will consist of the code for one of the 5 types of Non-functional Requirements followed by the sequential number.

Table 2.4: Non-functional requirements

PUI	Description
PR-001	The system shall run in a mobile application environment to ensure accessibility for all users via their smartphones.
PR-002	The system shall respond to user requests within 2 seconds to provide a seamless experience during high-demand situations.
PR-003	The system shall be updated at least once a week to ensure that all features and security protocols are up to date.
PC-001	The system shall be compatible with Android and iOS operating systems for broader usability.
PC-002	The back end shall utilize a SQL database to securely store user information, flight data, voucher details.
PC-003	The back end shall utilize a MongoDB database to securely store map data.
AP-001	The system shall differentiate between different users based on unique user credentials (username and password).
AP-002	User input shall be case-sensitive to prevent unauthorized access and ensure accurate data entry.
AP-003	The system shall inform the admin of any login failures after 3 unsuccessful attempts to prevent brute force attacks.
AD-001	The system shall allow admins to add, remove, or modify user accounts without requiring code changes or downtime.
AD-002	The system shall adapt to platform updates seamlessly, ensuring no disruption in service for users.
SC-001	The system shall require multi-factor authentication for users to enhance security during the login process.

SC-002	The system shall encrypt data exchange between the client and server using SSL to ensure data security.
SC-003	If a brute force hacking attempt is detected, the user's account shall be temporarily locked for 15 minutes.
SC-004	If a user forgets their password, the system shall provide a secure password recovery process, including verification steps.

Part 3. Data and process modeling

3.1 Overview and purposes

Data and Process Modeling focus is creating structured models to represent how data flows within the enhanced Vietnam Airlines mobile application, detailing interactions and processes that ensure seamless functionality. This phase uses tools such as Data Flow Diagrams (DFDs) and Process Description methods to analyze and visualize the app's core upgrades, including real-time GPS navigation for gate finding and automated voucher distribution for delays. The purpose is to establish a clear, logical framework that aligns with Vietnam Airlines' operational objectives, enhancing user experience, efficiency, and support capabilities by mapping essential processes and data interactions.

3.2 Deliverables

The main deliverables for data and process modeling in this project include:

- Data Flow Diagrams (DFDs) - DFDs illustrate the flow of data across the app, representing key processes, data sources, and storage points, essential for understanding user interactions like voucher issuance and GPS navigation.
- Data Dictionary - This document lists all data elements used in the application, defining attributes, formats, and relationships, ensuring data consistency across features such as user accounts, vouchers, and navigation data.
- Process Descriptions - Detailed descriptions for each key process in the DFD, such as GPS-based gate navigation and voucher issuance rules, using structured English and decision tables. These descriptions clarify decision logic and ensure the app's processes are user-friendly and robust.

These deliverables support the structured design of the app, ensuring that each feature works harmoniously within the broader system, and provide a foundation for consistent data management and streamlined passenger support.

3.3 Recommended functions

Vietnam Airlines should incorporate two key functionalities: View Airport Maps and Check Flight Status and Vouchers. These enhancements are designed to elevate the passenger experience by facilitating navigation and providing real-time information and benefits, ultimately contributing to greater passenger satisfaction and improved operational efficiency.

View Airport Maps feature offers passengers digital layouts of airport facilities, highlighting essential areas such as boarding gates, check-in counters, lounges, restrooms, dining options, and shopping zones. Accessible through the mobile application, this feature alleviates the cognitive burden on passengers by providing a visual guide, which is especially useful for navigating unfamiliar airports. By supporting passengers' spatial awareness, this function helps minimize delays associated with finding important locations within the terminal. This functionality will be designed to integrate with real-time data, enabling passengers to receive live updates on gate changes or other pertinent information. This adaptability is crucial in a dynamic airport environment where delays, gate relocations, and other disruptions are frequent. By embedding this functionality, Vietnam Airlines not only aligns with digital transformation trends but also fosters efficient passenger flow and alleviates congestion during peak travel hours.

The Check Flight Status and Vouchers feature provides real-time access to flight information, encompassing departure and arrival times, potential delays, and boarding updates, all conveniently accessible through the airline's mobile application. This level of transparency in flight tracking empowers passengers to manage their travel plans more effectively and alleviates the anxiety often associated with uncertain schedules. Additionally, this feature incorporates an integrated voucher system, offering passengers benefits such as meal vouchers during delays. The introduction of such compensatory measures aligns with service recovery strategies, aimed at alleviating passenger dissatisfaction stemming from delays.

The dual functionality of delivering flight status updates alongside compensatory vouchers underscores Vietnam Airlines' commitment to a customer-centered service model. This initiative not only keeps passengers informed but also fosters good will toward

the airline, which has proven to enhance customer loyalty and brand reputation. By leveraging digital engagement, Vietnam Airlines demonstrates its dedication to customer retention, showcasing how technology can enrich the passenger experience through convenience and personalized service.

3.4 Business process Modeling (BPMN) for the new system

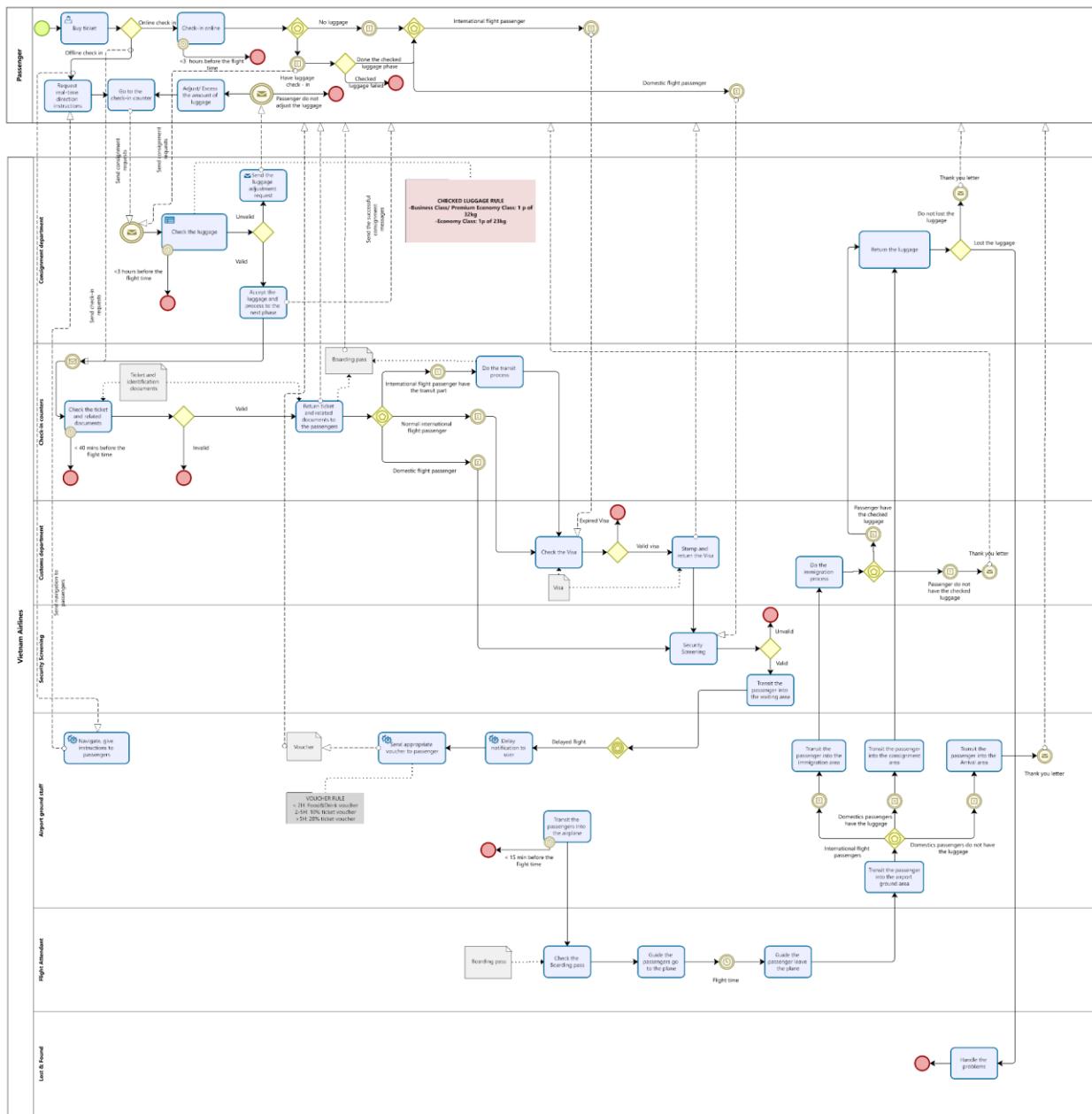


Figure 3.1: New system diagram of Vietnam Airlines

3.4.1 View airport maps

The BPMN diagram showcases a well-structured workflow for passengers accessing the View Airport Maps feature within an airline's mobile application, emphasizing efficient navigation and user-centric design. The process begins when the passenger initiates a map request and follows a secure, authenticated pathway to deliver personalized guidance throughout the airport environment. Upon successful authentication, the system presents a

dynamic, interactive map that pinpoints the passenger's current location and allows them to select points of interest, such as boarding gates or amenities. This interactive feature facilitates personalized navigation, helping passengers navigate complex layouts with real-time updates and step-by-step directions. Additionally, the system provides notifications regarding any significant changes, such as gate relocations, ensuring that passengers remain well-informed. The diagram highlights a seamless integration of security measures, user autonomy, and responsive design. By enabling users to take control of their navigation experience and providing assistance when necessary, this process represents an effective method for airport navigation.

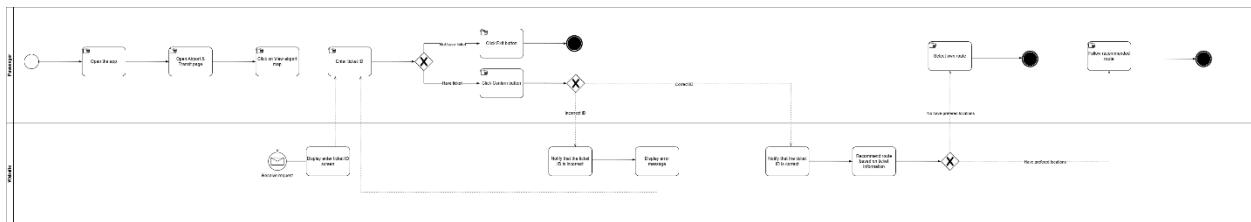


Figure 3.2: BPMN for View airport maps

3.4.2 Check flight status and vouchers

The BPMN diagram illustrates the Check Flight Status and Vouchers process, outlining the steps a passenger takes to access real-time flight information and vouchers through an airline's mobile application. This process is designed to enhance passenger satisfaction by delivering timely updates and compensatory benefits, particularly in instances of flight delays. The process begins when the passenger initiates a request to check the flight status, prompting the system to authenticate the user to ensure secure access. Once verified, the system retrieves the most recent flight information, including critical details such as departure and arrival times, gate information, and potential delays. This real-time data empowers passengers to better plan their schedules, alleviating anxiety and improving the overall travel experience. In the case of a delay, the system triggers a voucher issuance process, providing eligible passengers with vouchers, typically for dining or other amenities, as a form of compensation. This mechanism underscores the airline's commitment to service recovery, aiming to alleviate dissatisfaction by offering tangible benefits that enhance the perceived value of its services. Passengers can then redeem these vouchers at designated locations within the airport.

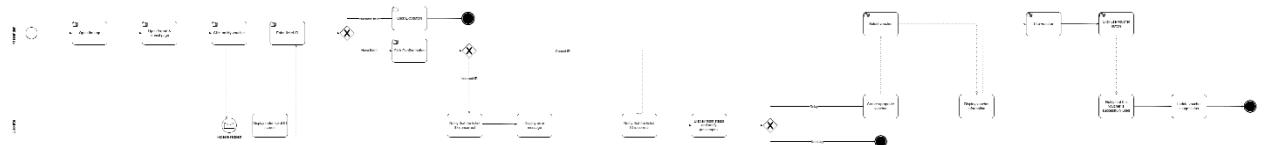


Figure 3.3: BPMN for Check flight status and vouchers

3.5. Requirement modeling by DFD (Data Flow Diagram)

The Vietnam Airlines App Enhancement project, DFD is used to model the requirements. The project focuses on supporting customers when flights are delayed and enhancing the user experience when traveling within the airport.

3.5.1 Data sources, data flows, data store, data destinations, and process

The data source primarily involves the passenger, who provides essential reservation details when purchasing a ticket. This includes personal information, such as their name, phone number, and email address, as well as flight specifics, including the departure location, destination, date, and time. Additionally, passengers may include special requests, such as seat preferences or meal choices.

The data flow begins with the passenger submitting their reservation information to the system upon making a reservation. After processing, the system returns the ticket and confirmation details to the passenger. Once payment is completed, the system provides the passenger with a ticket that contains a unique ticket number and flight details. This ticket information flows through various departments, including the Consignment Department, Check-in Department, Security Department, Ground Staff, and Ticket Department, ensuring that each division has the necessary information to effectively serve the passenger. The Ticket Department plays a crucial role in managing and verifying ticket details, ensuring that all ticket-related transactions are accurately recorded. Following successful check-in, the system issues a boarding pass, which serves as confirmation of the passenger's right to board the aircraft. For international flights, the system forwards the passenger's visa and passport information to the Customs Department for verification, ensuring compliance with entry and exit requirements. In cases of flight delays or special assistance needs, voucher information is sent from Ground Staff to passengers, providing access to supplementary services.

Data stores play a critical role in managing various aspects of passenger information. The ticket store holds and manages all ticket-related information, supporting operational activities across departments by facilitating ticket verification during check-in and boarding. The boarding store tracks and manages the boarding status of passengers,

ensuring that only those who have completed check-in are permitted to enter the boarding area or board the aircraft. The airport locations store provides information about various airport facilities and services, aiding passengers in navigating the terminal and locating specific areas. Furthermore, the voucher store maintains data regarding vouchers issued to passengers for special assistance or delayed flights, ensuring the accurate management and distribution of services. Lastly, the account store safeguards passenger account information, including usernames and passwords, thereby ensuring secure authentication and access control to the system.

Data destinations are integral to the overall operational process. The Consignment Department receives ticket information to manage checked luggage, ensuring that it is loaded onto the appropriate flight and complies with regulatory requirements. The Check-in Department accesses ticket details to complete the check-in process, verify special requests, and issue boarding passes. The Ticket Department ensures that ticket information is accurately recorded and available to all relevant departments for operational efficiency. For international passengers, the Customs Department validates travel documents, such as visas and passports, ensuring compliance with immigration laws. The Security Department utilizes ticket information to conduct identity checks and baggage screenings, thereby enhancing safety and ensuring adherence to security protocols. Additionally, the Ground Staff assists passengers by referencing ticket details and distributing vouchers in cases of flight delays. The Flight Crew verifies boarding eligibility by checking the boarding pass, ensuring that only authorized passengers are permitted to board the aircraft.

The key processes within this operational framework include the initial ticket purchase, during which passengers acquire tickets through the system or other sales channels. The system captures reservation details and issues a ticket for each passenger. Passengers can also request navigation assistance, where the system provides them with airport maps and guidance on locating gates and services. The luggage check process ensures that checked luggage is registered and transferred correctly to the intended flight. During the check-in process, ticket details are verified, and boarding passes are issued to confirm the passenger's readiness for travel. For international flights, travel document verification is performed to ensure the validity of visas and passports, while security checks are conducted

to screen passengers and their carry-on baggage. In instances of flight delays, passengers may wait in the transit lounge until boarding resumes, and the system provides vouchers for supplementary services or compensation. Finally, passengers are guided from the terminal to the boarding area, where their boarding passes are verified by the Flight Crew before they complete the boarding process and take their assigned seats.

3.5.2 Context diagram – Context level

The Context Level Data Flow Diagram (DFD) provides a comprehensive depiction of an airline system's interactions with its external entities, illustrating the systematic flow of information across various operational components. Central to the diagram is the Airline System, serving as the principal process node that interfaces with multiple stakeholders through distinct data flows. The system's architecture showcases sophisticated interconnectivity, particularly in its relationship with passengers. This interface features bidirectional data exchange, involving the input of personal information and the delivery of critical outputs such as ticket details, boarding documentation, and vouchers. This unique bilateral communication pattern applies solely to the passenger entity, while all other stakeholders operate under unidirectional data flows. Departmental integration within the airline ecosystem is demonstrated through specialized information channels. The ticket department, consignment department, and check-in department all receive relevant ticket information, with the check-in department additionally processing boarding pass data. The customs department maintains a dedicated channel for visa and passport information, whereas the security department receives specific ticket-related data. Ground staff operations benefit from streams of both ticket and voucher information, and the flight crew obtains the necessary boarding pass details. The diagram's structure reveals a centralized data distribution model, where similar information types, particularly ticket data, are disseminated to multiple departments. This arrangement indicates a robust information management system capable of preserving data consistency across various operational units while ensuring appropriate access to relevant information. This context-level representation effectively establishes the boundaries of the system and illustrates the fundamental interactions between the airline system and its external stakeholders,

providing a clear framework for understanding the scope and complexity of information management in airline operations. The architecture of the diagram underscores the critical role of structured data flows in maintaining efficient airline operations and facilitating stakeholder communications.

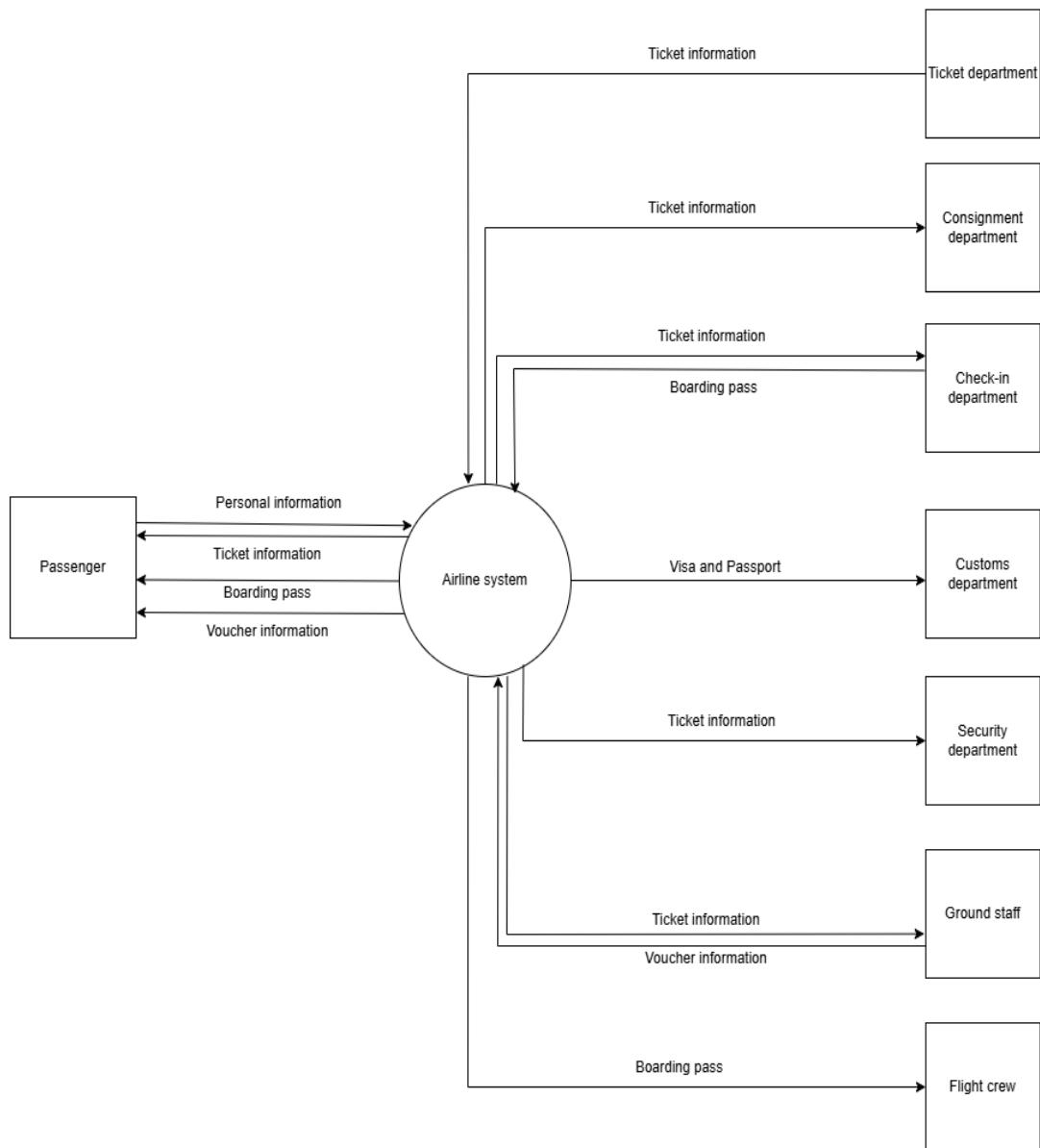


Figure 3.4: Context diagram – Context level

3.5.3 Level 0 of DFD

This Level 0 Data Flow Diagram provides a comprehensive breakdown of the operational processes within an airline system, showcasing a complex network of interconnected functions and data flows. The diagram outlines eleven key processes, numbered from 1.0 to 11.0, each representing distinct phases in both the passenger journey and the management of airline operations.

The system architecture begins with Process 1.0 (Buy Ticket), where personal and ticket information converge to kick off the passenger processing sequence. This process interacts with Process 2.0 (Report from Reception), which handles airport location data. The workflow then advances to Process 3.0 (Check Luggage), facilitating communication with the consignment department via ticket information channels.

A crucial operational point occurs at Process 4.0 (Check-in), where the system processes boarding passes and interfaces with the check-in department. The diagram illustrates a complex branching at Process 5.0 (Check-in Travel Documents), where the flow diverges based on whether the flight is domestic or international, with international flights requiring additional visa and passport verification through the customs department. Security protocols are overseen by Process 6.0 (Check Security), which ensures data exchange with the security department. The system incorporates delay management through Process 7.0 (Wait in the Transit Lounge), which splits based on flight delay status. Process 8.0 (Voucher) is responsible for managing voucher information distribution, while Process 9.0 (Transit Passengers) coordinates communications with ground staff.

The final phases of the process flow encompass Process 10.0 (Check the boarding pass), coordinating with flight crew, and culminate in Process 11.0 (Get on the plane). This terminal process represents the successful completion of the passenger processing sequence. The diagram effectively captures the complexity of data flows and process interdependencies within the airline system, demonstrating how information traverses between various operational entities and departments. The structured representation enables comprehensive understanding of the system's logical organization and operational workflow, particularly in managing passenger movement from ticket purchase through to boarding. This Level 0 DFD serves as a crucial documentation artifact, providing

stakeholders with a clear visualization of system processes and their interactions, while maintaining sufficient detail for system analysis and potential process optimization initiatives.

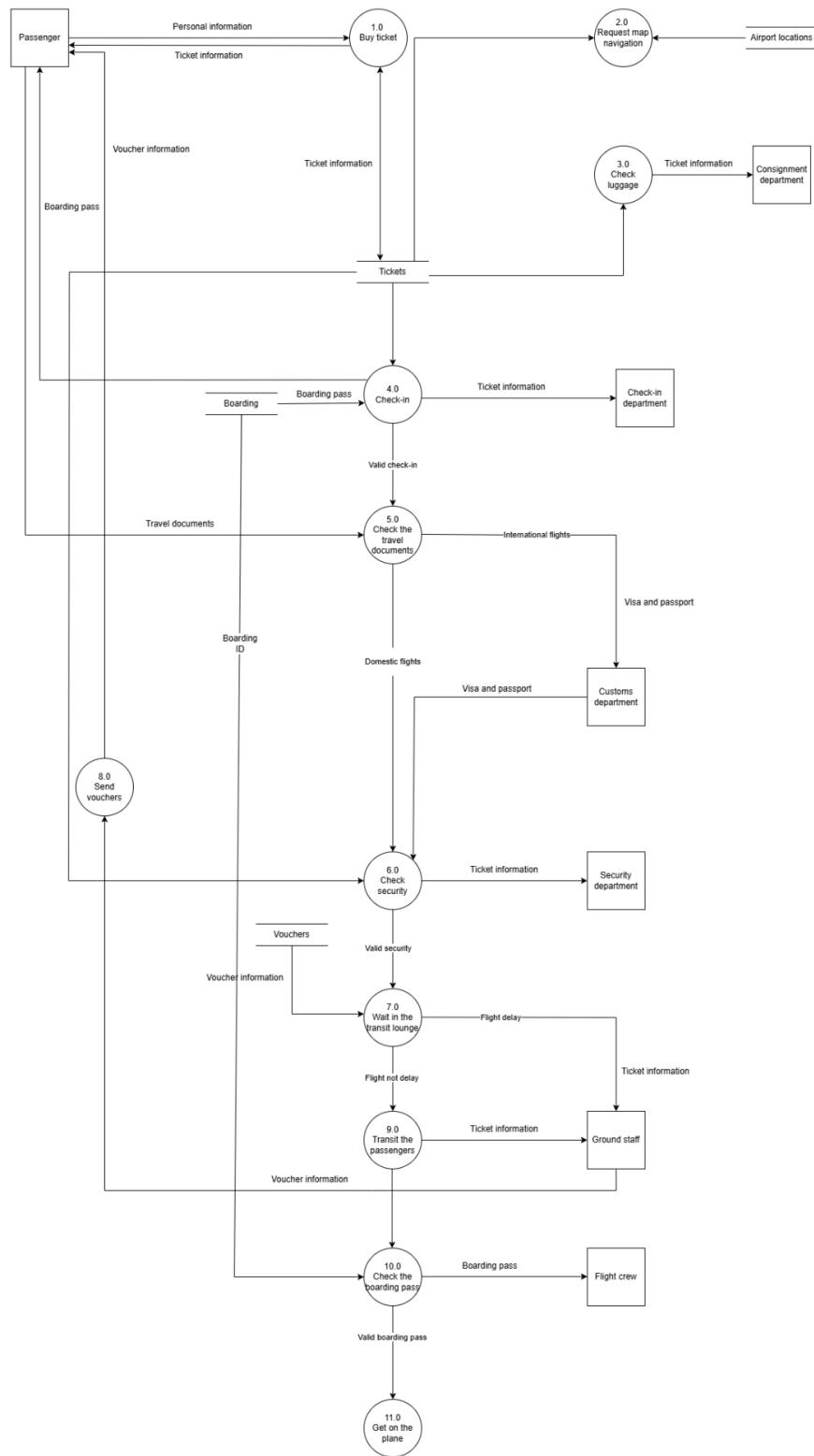


Figure 3.5: Context diagram – level 0

3.5.4 Level 1 of DFD

This Level 1 Data Flow Diagram provides a comprehensive breakdown of the ticket purchasing process within an airline system, specifically highlighting Process 1.0 (Buy Ticket) from the overarching diagram. The diagram outlines a sophisticated workflow for authentication and seat reservation, consisting of five distinct sub-processes, numbered from 1.1 to 1.5.

The process begins with a decision point that depends on the user's authentication status. For new users, Process 1.1 (Sign Up) allows for account creation, with credentials stored in the Accounts data store. Existing users can proceed directly to Process 1.2 (Login), where their authentication credentials are validated against the stored account information. This login process includes error handling; if incorrect credentials are provided, a notification is sent back to the user. Conversely, successful authentication enables the user to move forward to the reservation phase.

Process 1.3 (Reserve ticket) embodies the essential transaction functionality, bridging the interaction between the passenger and the ticket department. This process effectively manages a variety of data streams, including seat preferences, scheduling requests, and passenger details (such as name and route). To ensure data consistency, it maintains bilateral communication with Process 1.4 (Check schedule), which validates date preferences against available schedules.

The final component, Process 1.5 (Check seat), guarantees the integrity of seat allocation through direct interaction with the ticket department. This process oversees seat number verification and updates, ensuring synchronization between passenger preferences and actual seat assignments.

The diagram skillfully illustrates the system's data persistence via the Accounts data store and elucidates the intricate relationships among user authentication, schedule verification, and seat allocation processes. Its structured representation offers a clear visualization of error handling mechanisms and data validation procedures, which are vital for maintaining system integrity during ticket purchasing operations. This Level 1 DFD serves as comprehensive documentation of the ticket purchasing subprocess and highlights the complex interdependencies between user authentication, reservation management, and

seat allocation within the airline booking system. The diagram's detailed granularity aids in system analysis and potential process optimization, while clearly representing the logical flow of operations.

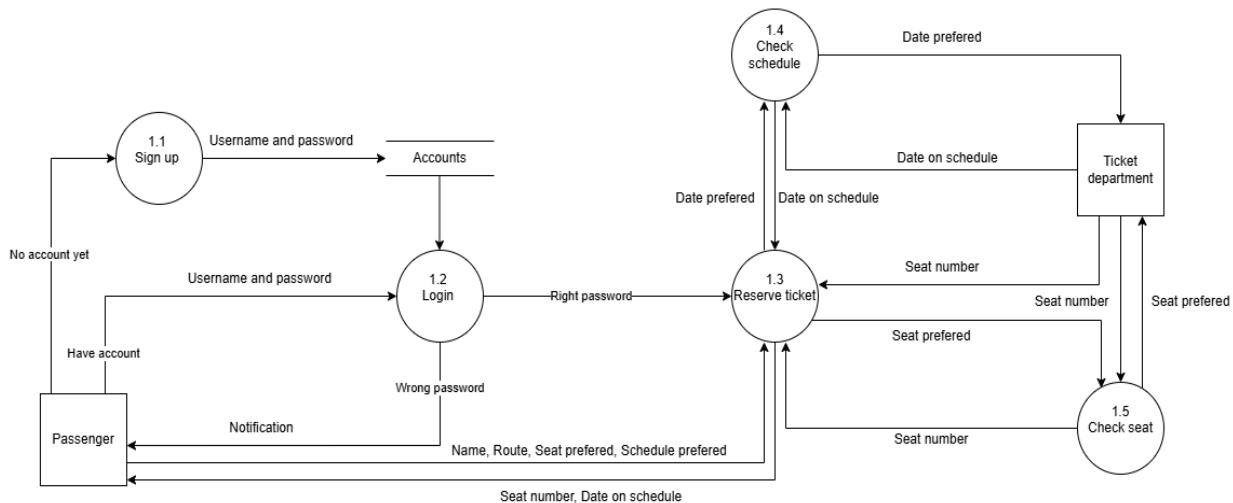


Figure 3.6: Context diagram – level 1: Buy tickets

This Level 1 Data Flow Diagram outlines the comprehensive process flow for flight status monitoring and voucher management within the airline system, focusing specifically on Process 7.0 from the higher-level diagram. It provides a systematic breakdown of five interconnected sub-processes, numbered from 7.1 to 7.5, which detail the management of flight delays and the corresponding compensation mechanisms.

The process begins with Process 7.1 (Receive delay notification), which acts as the initial communication point between ground staff and passengers. This process facilitates bidirectional notification flows, ensuring that delay information is effectively conveyed to all relevant stakeholders. The ticket information is then relayed to Process 7.2 (Update flight status), which maintains the current state of flight operations.

After the status updates are implemented, the workflow continues to Process 7.3 (Create appropriate vouchers), which interacts with a dedicated Vouchers data store. This process highlights the system's capabilities in compensation management by generating vouchers based on flight delay parameters. The voucher creation process ensures data integrity through structured communication with ground staff.

Subsequent processes, 7.4 (Send voucher) and 7.5 (Use voucher), manage the distribution and redemption phases of the voucher lifecycle. These processes guarantee proper delivery and utilization of vouchers, thus completing the compensation workflow for affected passengers.

The diagram effectively illustrates the sequential nature of delay management and compensation procedures, showcasing a systematic approach to accommodating passengers during service disruptions. It offers a clear representation of data flows between processes and external entities while maintaining a logical separation of concerns in voucher management operations. This Level 1 DFD serves as an essential documentation artifact, providing stakeholders with a thorough understanding of the airline's delay management and compensation mechanisms. The diagram's structure supports both system analysis and process optimization initiatives, particularly in scenarios that require efficient handling of service disruptions and passenger compensation.

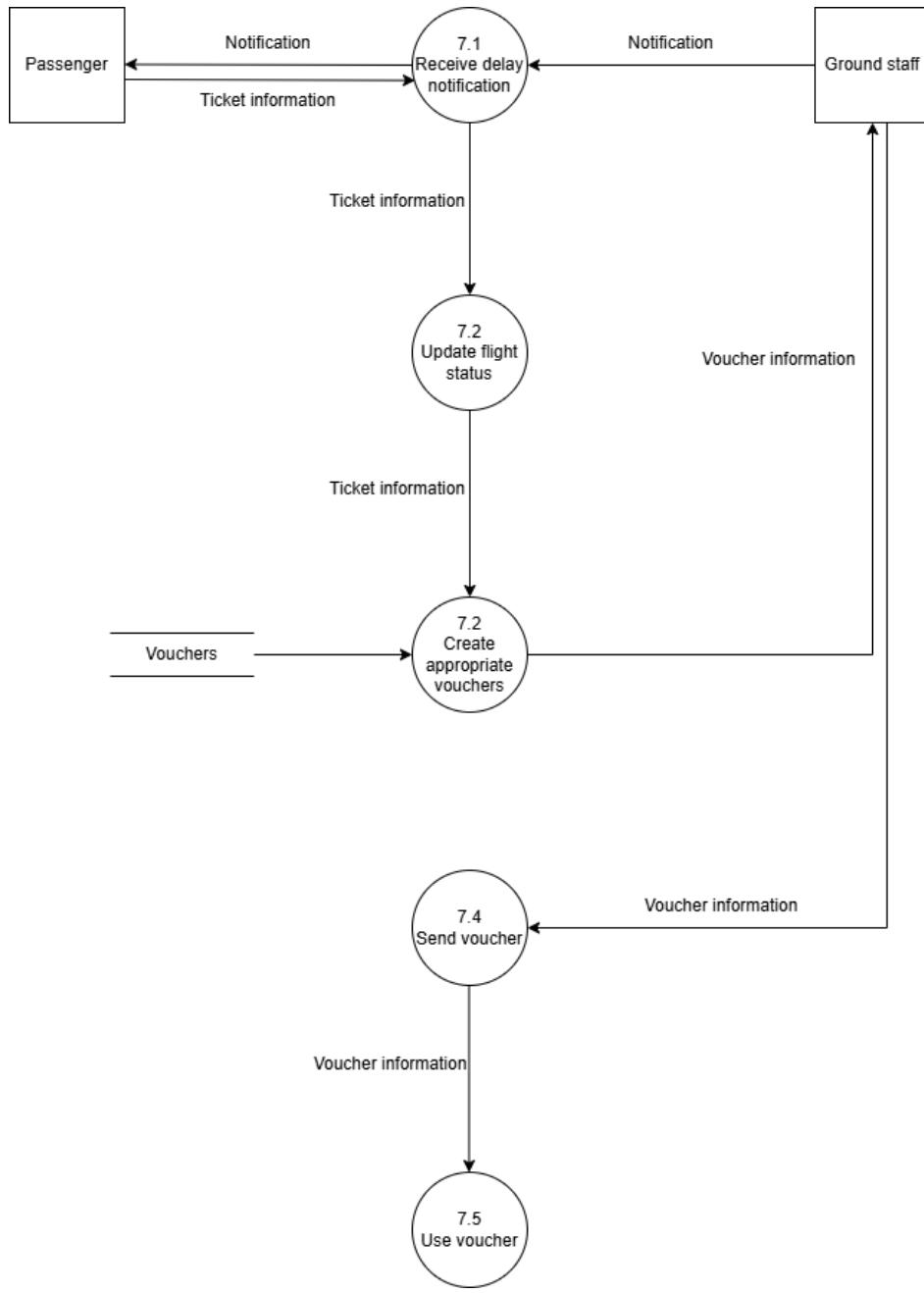


Figure 3.7: Context diagram – level 1: Check flight status and vouchers

This Level 1 Data Flow Diagram illustrates the intricate route recommendation and selection system embedded within the airport navigation functionality of the airline. It encompasses four distinct sub-processes, numbered from 2.1 to 2.4. The diagram outlines a logical sequence of steps designed to enhance passenger navigation through airport facilities based on ticket information and location preferences.

The process begins with Process 2.1 (Enter ticket ID), which interacts with both the passenger entity and the Tickets data store. This initial phase serves as a crucial authentication and validation step, ensuring that subsequent route recommendations align with the passenger's flight details and terminal assignments.

Once ticket validation is complete, Process 2.2 (Recommend route) showcases the system's intelligent routing capabilities by integrating data from the Airport locations data store. This process represents a vital decision point in the workflow, where the system evaluates available routing options based on predefined criteria and passenger preferences.

The diagram also features a conditional branching mechanism based on location preferences. If preferred locations are not specified, the flow diverts to Process 2.3 (Select own route), allowing passengers to navigate autonomously. Conversely, when preferred locations are indicated, the workflow advances to Process 2.4 (Follow recommended route), which provides optimized pathfinding through airport facilities.

This Level 1 DFD effectively encapsulates the system's capacity to cater to both guided and self-directed navigation preferences, demonstrating flexibility in meeting diverse passenger needs. The structured representation clarifies the logical relationships between ticket validation, route recommendation, and passenger choice, while ensuring clear data flow paths among processes and data stores. This diagram serves as a vital documentation artifact for understanding the airport navigation subsystem, offering stakeholders a clear visualization of the route recommendation and selection processes. This detailed representation supports system analysis and highlights potential enhancements to improve passenger wayfinding experiences within airport environments.

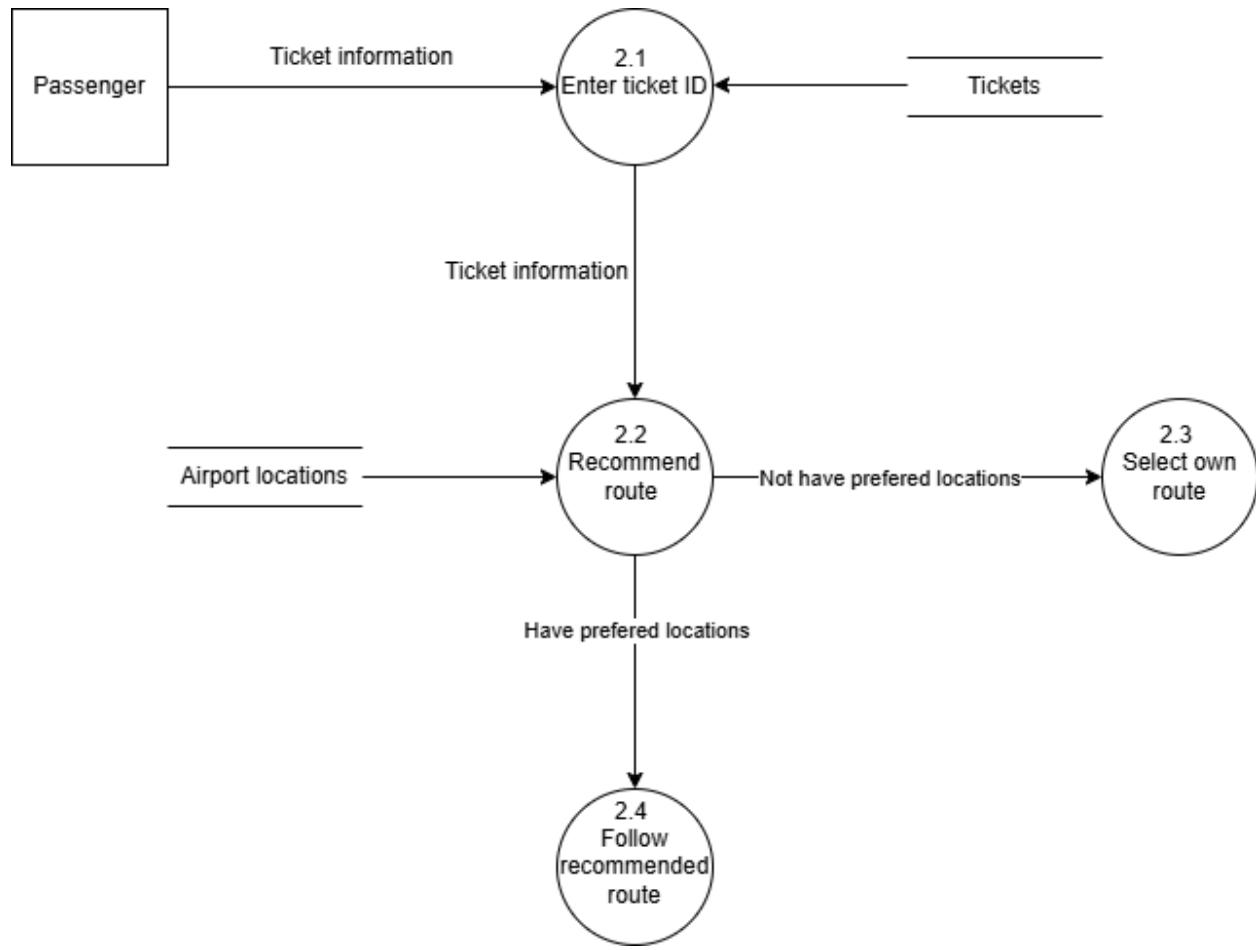


Figure 3.8: Context diagram – level 1: View airport maps

3.6 Data Dictionary

3.6.1 Data flow

Personal Information encompasses the demographic and identification details of passengers, including their names, ages, and contact information. This high-volume data flow originates from passengers and concludes at the Buy Ticket process, ensuring the maintenance of essential identification attributes and contact details. Ticket Information pertains to transactional data associated with ticket purchases and check-in activities. This data flow demonstrates complex routing, originating from several processes (Buy Ticket, Check Luggage, Check-in) and terminating at various destinations (Passenger, Tickets, Consignment Department, Check-in Department). Ticket Information maintains comprehensive records that include both ticket and passenger data, exhibiting high volume with frequent updates that correspond to ticket purchase activities. The Boarding Pass facilitates authorization for passenger embarkation, flowing from the Get on the Plane process to the Flight Crew. This medium-volume data flow includes critical information such as boarding pass numbers, flight details, and passenger identification, and is systematically updated based on ticket sales. Travel Documents represent a high-volume data flow between the Check-in and Customs Officer entities, containing vital verification documents such as passports, visas, and health records. These documents undergo frequent updates during passenger check-in processes. The Flight manages operational flight data, including scheduling and delay information. Originating from Flights and terminating at Check Delay, this medium to high-volume flow maintains current status and delay information, updated in accordance with flight schedules. Finally, Voucher Information signifies the compensatory data flow from Vouchers to Passengers, containing specifications of value, usage conditions, and expiration parameters. Voucher Information exhibits lower volume characteristics, with updates corresponding to voucher issuance events. This data dictionary serves as a critical reference for system stakeholders, providing detailed insights into data flow patterns, volume characteristics, and update frequencies within the airline system architecture. The structured documentation supports system maintenance, optimization initiatives, and future enhancement efforts.

No.	Name	Description	Origin	Destination	Record	Volume and Frequency
1	Personal information	Data related to the passenger, including name, age, etc.	Passenger	Buy Ticket	Name Age Contact information ID number	High volume; updated for each ticket purchase.
2	Ticket information	Represents the purchase of a ticket and check-in process	Buy ticket Check luggage Check in	Passenger, Tickets Consignment department Check in department	Ticket information Passenger information Flight information	High volume; updated frequently as tickets are purchased.
3	Boarding pass	Document that allows passengers to board the plane	Get on the plane	Flight crew	Boarding pass number Flight information Passenger identification	Medium volume; updated per flight based on ticket sales.
4	Travel documents	Collection of required documents for check-in	Check in	Custom Officer	Passport Visa Health records	High volume; updated for each passenger at check-in.
5	Flight	Data regarding flight details, including delays	Flights	Check delay	Flight number Departure and arrival times Status Delay information	Medium to high volume; updated per flight schedule.
6	Voucher information	Represents the issuance of vouchers to passengers	Vouchers	Passengers	Value Using conditions Expiration date	Low volume; updated as vouchers are issued.

Figure 3.9: Data flow

3.6.2 Data store

The Airport Locations data store serves as a crucial source for spatial and infrastructural information, featuring attributes such as Location ID, Airport Name, Terminal Number, Gate Number, Lounge Area, Location Type, Country, and City. This foundational data store is characterized by low volume, receiving infrequent updates that mainly occur during infrastructure modifications or expansions of airline operations. The Accounts data store houses comprehensive user authentication and profile data, which includes attributes like Account ID, Username, Password, Full Name, Email, Phone Number, Role, Account Status, Creation Date, and Last Login. This high-volume database undergoes regular updates driven by new registrations, authentication activities, and profile changes, reflecting the dynamic nature of user account management. The Tickets data store serves as the central hub for flight booking information, containing essential attributes such as Ticket ID, Passenger ID, Flight Number, Seat Number, Booking Date, Departure Date, Arrival Date, Fare Class, Payment Status, and Ticket Status. This vital data store experiences high transaction volumes and frequent updates due to new bookings and cancellations, demonstrating the system's robust capability in managing reservations. The Boarding data store facilitates real-time tracking of passenger movements, maintaining attributes such as Boarding Pass ID, Gate Number, Boarding Time, Boarding Status, and Security Clearance Time. This store is characterized by high volume and real-time updates during boarding periods, ensuring accurate management of passenger flow throughout airport facilities. The Vouchers data store is responsible for managing promotional and compensation offerings, with key attributes including Voucher ID, Discount Amount,

Expiration Date, Issue Date, Voucher Type, Partner ID, Terms and Conditions, and Usage Limit. This data store typically exhibits low to medium volume characteristics, with updates occurring intermittently, primarily driven by promotional campaigns and service compensation events. This structured documentation of data stores serves as a crucial reference for system architects, developers, and administrators, enhancing data management and system maintenance efforts. The comprehensive listings of attributes and their update characteristics provide insights into data relationships and patterns of system behavior within the context of airline operations.

No.	Name	Description	Attributes	Volume and frequency
1	Airport Locations	Stores information about various airport locations where the airline operates, including gates, terminals, and lounges.	Location ID Airport Name Terminal Number Gate Number Lounge Area Location Type Country, City	Low volume, updated infrequently based on new locations or changes in airport infrastructure.
2	Accounts	Stores account information for passengers and staff, including login details and profile data.	Account ID Username Password Full Name Email Phone Number Role Account Status Creation Date Last Login	High volume, updated regularly based on new registrations, logins, and account updates.
3	Tickets	Holds data on flight tickets, including details for each booking, seat assignment, and fare.	Ticket ID Passenger ID Flight Number Seat Number Booking Date Departure Date Arrival Date Fare Class Payment Status Ticket Status	High volume, updated frequently with new bookings and cancellations.
4	Boarding	Track passengers when they pass gates.	Boarding Pass ID Gate Number Boarding Time Boarding Status Security Clearance Time	High volume, updated in real-time during boarding periods
5	Vouchers	Manage offers from partners and provide them to passengers.	Voucher ID Discount Amount Expiration Date Issue Date Voucher Type Partner ID Terms and Conditions Usage Limit	Low to medium volume, updated occasionally

Figure 3.10: Data store

3.6.3 Entity

No.	Name	Description	Input data flows	Output data flows
1	Passenger	Individuals who book flights, make payments, and board flights. They are the primary users of services.	Ticket information, Boarding pass, Voucher information	Personal information, Username and password
2	Ticket department	Department responsible for managing ticket reservations, seat assignments, and issuing tickets.	Seat number and Date Preferred	Ticket information
3	Consignment department	Department that manages the handling and tracking of checked luggage and cargo items for passengers.	Ticket information	
4	Check-in department	Department responsible for passenger check-in, assigning seats, and issuing boarding passes.	Ticket information	Boarding pass
5	Customs department	Department that verifies travel documents such as visas and passports for international passengers.	Visa and Passport	Ticket information
6	Security department	Department responsible for conducting security checks on passengers and baggage to ensure safety.	Ticket information	
7	Ground staff	Employees who handle airport operations such as check-in, baggage handling, and boarding assistance.	Ticket information, Voucher information	Voucher information
8	Flight crew	Personnel responsible for operating the flight, including pilots and cabin crew members.	Boarding Pass	

Figure 3.11: Entity

3.6.4 Process:

This journey commences with Ticket Purchase (1.0), where travelers obtain their flight tickets through an online platform, mobile app, or at a physical ticket counter. This process involves selecting travel options, providing personal information, and completing the payment. For first-time users, the Sign Up (1.1) process allows for registration on the airline's digital platform, granting access to personalized travel information and booking services. Subsequent visits to these services are facilitated through Login (1.2), an authentication procedure that enables users to manage their bookings and view reservation details. For those still finalizing their plans, the Ticket Reservation (1.3) option allows travelers to temporarily hold a seat on the flight without immediate payment, offering flexibility in decision-making. As travel dates draw near, passengers may check Flight Schedules (1.4) to confirm departure and arrival times, an essential step in their planning. Additionally, they can utilize the Seat Check (1.5) feature to review available seating options and make adjustments based on their preferences for convenience or comfort. Upon arriving at the airport, passengers may require Map Navigation Assistance (2.0) to guide them in locating key airport facilities such as terminals, gates, baggage claim areas, and lounges. The next step is Luggage Check-In (3.0), where passengers hand over their baggage for verification, tagging, and loading onto the aircraft. Following this is Check-In (4.0), which confirms the passenger's attendance on the flight, facilitates seat selection, and issues boarding passes, allowing them to proceed to the subsequent pre-boarding processes. In preparation for security screening, Travel Document Verification (5.0) is performed to ensure that passengers possess the necessary documents, such as passports and visas, to meet the requirements of their destinations and transit points. This is followed by Security

Screening (6.0), which includes procedures such as baggage scanning and body checks to ensure compliance with airport security protocols. Once security is cleared, passengers enter a designated waiting area, known as the Transit Lounge (7.0), where they remain until boarding begins. In cases of prolonged waiting times or special travel arrangements, Voucher Distribution (8.0) may take place, providing eligible passengers with vouchers for services like meals or beverages. As boarding commences, Passenger Transit (9.0) facilitates the controlled movement of passengers from one location to another within the airport, such as between terminals or from the terminal to the aircraft, with assistance from airport or airline staff. Prior to entering the boarding area, Boarding Pass Verification (10.0) is conducted by airline personnel to confirm passenger eligibility for boarding. The journey culminates with Aircraft Embarkation (11.0), where passengers are allowed to board the plane at the designated gate upon presenting their boarding pass. This comprehensive sequence not only ensures the smooth flow of passengers from ticket purchase to aircraft boarding but also reinforces security and compliance at each stage. By standardizing these procedures, airlines and airport authorities create a structured, reliable, and streamlined travel experience for all passengers.

No.	Name	Number	Description
1	Buy ticket	1.0	Process of purchasing a flight ticket through an online platform, mobile app, or at the airport.
2	Sign up	1.1	Process where users create a new account on the airline's platform to access booking and travel services.
3	Login	1.2	Process where users log into their account to access booking, reservation, and travel information.
4	Reserve ticket	1.3	Process of reserving a flight ticket without immediate payment, securing a seat temporarily.
5	Check schedule	1.4	Process where passengers check flight schedules, including departure and arrival times, for planning purposes.
6	Check seat	1.5	Process where passengers view available seating options and select or verify their seats on the flight.
7	Request map navigation	2.0	Process where passengers request navigation assistance to locate terminals, gates, or other airport facilities.
8	Check luggage	3.0	Process where passengers hand over their luggage for check-in, which is then tagged and sent for loading.
9	Check in	4.0	Process where passengers confirm their presence on a flight, choose seats, and receive boarding passes.
10	Check the travel documents	5.0	Process of verifying passengers' travel documents, such as passports and visas, before proceeding to check-in.
11	Check security	6.0	Process where passengers undergo security checks, including baggage scanning and body checks.
12	Wait in the transit lounge	7.0	Process where passengers wait in the designated area after check-in and security checks, until boarding time.
13	Send vouchers	8.0	Process of distributing vouchers (e.g., meal or beverage vouchers) to eligible passengers.
14	Transit the passengers	9.0	Process of physically transporting passengers from the terminal to the plane or between terminals.
15	Check the boarding pass	10.0	Process where airline staff verify passengers' boarding passes before they enter the boarding gate.
16	Get on the plane	11.0	Process where passengers board the plane at the designated gate after showing their boarding pass.

Figure 3.12: Process

Part 4. Object modeling

4.1 Overview and purposes

Object Modeling, the aim is to design the system's components as interacting objects, focusing on encapsulating attributes and methods that represent real-world entities within the Vietnam Airlines app, such as "Passenger," "Flight," "Gate," and "Voucher." Object modeling, using the Unified Modeling Language (UML), will capture these entities and their relationships, providing a framework for scalable and maintainable code. This approach ensures that each feature, such as real-time navigation and voucher distribution, is effectively mapped to specific objects, supporting efficient data handling and process execution. Object modeling promotes reuse and flexibility, enhancing the app's adaptability and simplifying further updates.

4.2 Deliverables

The deliverables for object modeling in this project include:

- **Use Case Diagrams:** These diagrams identify and define interactions between users (e.g., passengers, customer service) and the system for core functions like gate navigation, voucher issuance, and check-in, outlining user-system relationships to ensure comprehensive user experience design.
- **Class Diagrams:** These diagrams represent classes such as "Passenger," "Flight," "Gate," and "Voucher," showing each class's attributes (e.g., gate location, voucher amount) and methods (e.g., generate voucher, locate gate). This structure helps define the app's functionality by organizing data and behaviors associated with each class.
- **Sequence Diagrams:** These diagrams model the sequence of operations for essential processes, such as navigating to a gate or applying a voucher during delays. They show the order of interactions between objects, which is critical for ensuring smooth and logical feature operation within the app.
- **Activity Diagrams:** These diagrams outline the flow of tasks for key functionalities, such as real-time gate navigation or automated voucher issuance during delays. They illustrate the sequential steps and decision points, ensuring a smooth and logical process flow within the app.

These deliverables provide a comprehensive blueprint for developing a structured and responsive system, enabling Vietnam Airlines to deliver a robust and adaptable mobile application that enhances user experience and operational efficiency.

4.3 Scenarios, Models and Functionality

4.3.1 Use Case Diagram

This use case diagram outlines the interactions among various actors and functionalities within the Vietnam Airlines website system. The three primary actors identified are the Passenger, Admin, and Employee, each possessing distinct roles and access levels to different use cases that reflect their specific responsibilities and privileges within the system.

The Passenger actor, representing the airline's customers, has access to a comprehensive range of self-service functionalities designed to enhance the user experience through direct engagement with the airline's digital services. Passengers can manage their flight bookings, including viewing ticket details, updating travel information, and canceling reservations when necessary. This use case is further extended by actions such as viewing available upgrade options or modifying seat selections, allowing passengers to tailor their bookings to their preferences. Additionally, passengers can search for flights using various parameters, such as destination, travel dates, and preferred flight times. This search capability is crucial for initiating the booking process and includes options for viewing flight details and comparing fare choices. Moreover, passengers have access to interactive airport maps that facilitate easy navigation through airport facilities. These maps highlight points of interest, including terminals, gates, and service areas, assisting passengers in planning their journey from arrival to boarding. The online check-in functionality enables passengers to select seats, receive electronic boarding passes, and modify check-in details as needed. In the event of delays or schedule changes, passengers may receive vouchers for services or amenities, which they can view, select, and redeem through the website. Furthermore, they can track the real-time status of their flights, receiving timely updates on schedules, delays, or cancellations, thereby enhancing the travel experience through proactive information delivery.

The Admin actor, representing administrative personnel, is tasked with managing the backend functions of the Vietnam Airlines website. Admins have access to privileged functionalities that enable them to oversee and control various system elements. Their

responsibilities include managing user accounts, which involves creating, updating, or deleting user profiles to ensure data accuracy and security. Additionally, admins can review system logs, offering insights into system operations, user actions, and potential security incidents. This role is essential for maintaining the integrity and security of the airline's digital infrastructure. Furthermore, admins are capable of generating operational and analytical reports that provide data-driven insights into system performance, user engagement, and service metrics, thereby supporting strategic decision-making within the airline.

The Employee actor, encompassing support staff and operational personnel, interacts with the system to facilitate service delivery and support passenger needs. Employees have access to passenger information, including booking details and travel history, which enables them to provide assistance effectively at various touchpoints within the airport. They can also update information regarding flight schedules, delays, and cancellations, ensuring that accurate and current information is available to passengers and other stakeholders. Employees have the authority to issue vouchers to passengers, particularly in cases of disruptions like flight delays or cancellations, which includes assigning vouchers and tracking their usage. This capability allows the airline to provide compensation when needed. Employees can also assist passengers with specific needs, such as wheelchair assistance, special meals, or priority boarding, reflecting the airline's commitment to accommodating diverse requirements and ensuring a comfortable travel experience.

This diagram also includes include and extend relationships that represent dependencies and optional actions within each use case. For example, the "Manage Flights" use case extends into detailed actions like viewing upgrades or modifying seat selections, offering passengers an enhanced service experience. Similarly, the "Access Voucher Services" use case includes options for viewing and redeeming vouchers, depending on the passenger's eligibility.

In this use case diagram, two proposed features, "View Real-Time Maps" (Use Case 22) and "Check Flight Status and Vouchers" (Use Case 17), are highlighted as significant enhancements to the Vietnam Airlines website, aimed at enriching the self-service experience for passengers by providing timely information. Passengers can interact with

the "View Real-Time Maps" feature (UC 22) directly from the main page, allowing them to visually explore airport amenities and services, which facilitates smoother navigation with updated information on terminals, gates, and service areas. Meanwhile, the "Check Flight Status and Vouchers" feature (UC 17) is located within the "Manage Booking" section to monitor their flight status in real time and access service vouchers when eligible, especially valuable in cases of delays or disruptions. This functionality provides continuous updates on schedules, cancellations, or changes and allows passengers to easily receive and redeem vouchers when needed, promoting transparency and convenience in customer satisfaction enhancement..

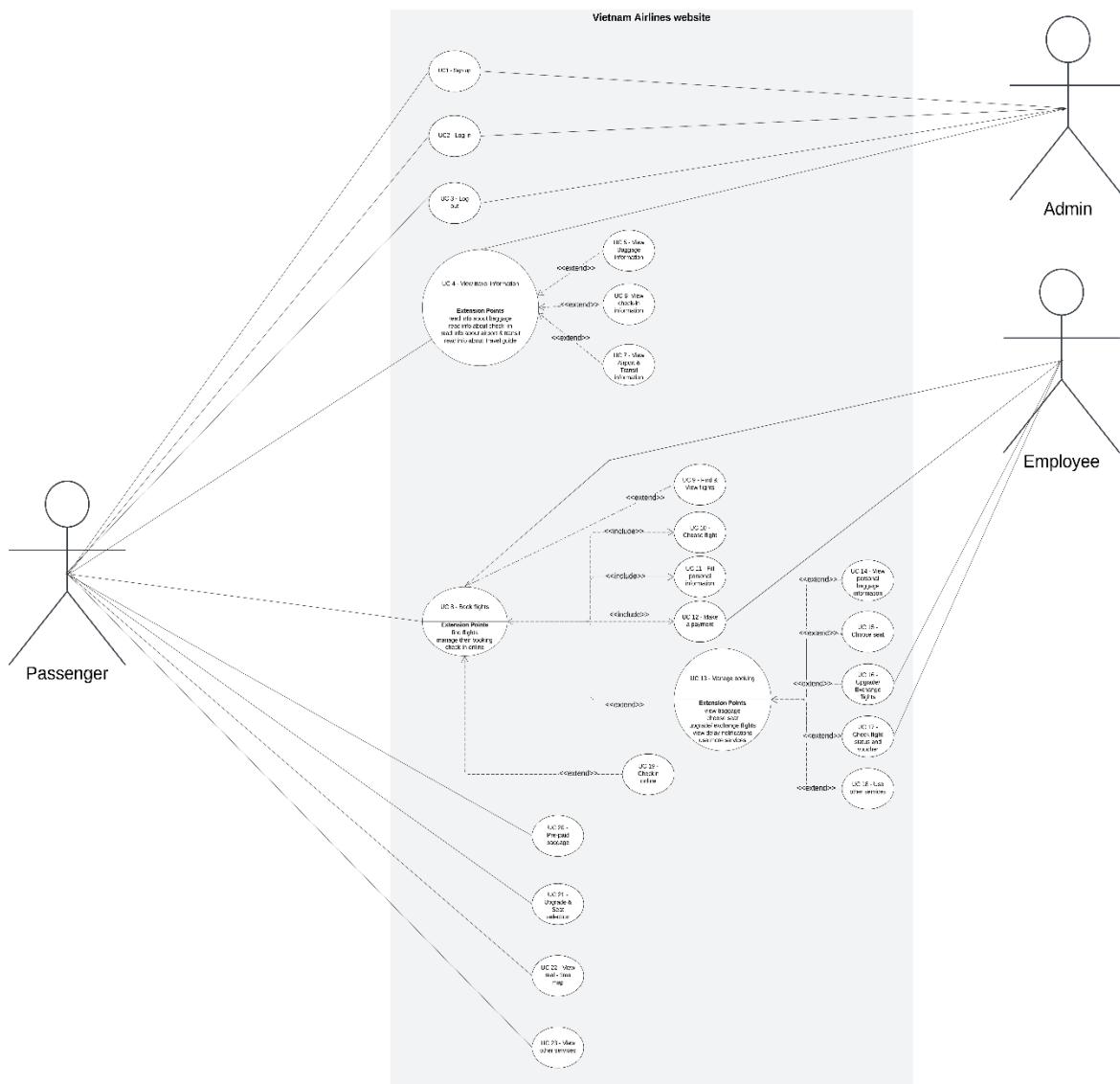


Figure 4.1: Use case diagram of Vietnam Airlines

4.3.2 Use Case Descriptions

Table 4.1: Use Case Descriptions Check flight status and vouchers

UC Name	Check flight status and vouchers		Use case description
UC #	17		This use case enables passengers to check the status of their flight and use a voucher if the flight delays. The passenger can enter their ticket ID, view flight information, and apply a voucher for compensation. The system also handles incorrect ticket entries and provides confirmation of voucher usage.
Primary Actor	Passenger		
Use Case Story	This use case enables the user to check the new flight status and vouchers can receive when the flight is delayed		
Trigger	Flight management system detect a flight delay		
Pre-Condition	1. Passenger needs to be a registered online user 2. User account must be active (not locked) 3. User must have a good internet connection		
Post-Condition	User is able to view account summary page		
Primary Flow (PF)	Title: User checks flight status and retrieves vouchers after delay		
	Actor Action		System Response
	1) On the main screen, user clicks the “Manage Booking” hyperlink.		
	2) System navigates the user to the “Manage Booking” page in a		

		<p>new window.</p> <p>if not back page, go to next step.</p> <p>if back page, go to AF1</p>
3) Enter the Ticket ID and last name, then click "Search."		
		<p>4) System performs validations: required fields, valid Ticket ID and last name format. If valid, go to next step. If invalid, go to EF1.</p>
		<p>5) System displays "Manage Booking".</p>
6) User click "Flights status" button		
		<p>7) System displays notification on the flight status. if delay , go to next step. if not delay, go to AF2.</p>
8) User click "View detail Voucher" button.		
		<p>9) System displays List E-Voucher page.</p>
10) Users select the vouchers they wish to redeem.		

		11) The system displays a QR-code page for the selected E-voucher.
	12) Users uses Voucher with QR-Code	
Alternative Flow (AF1)	Title: Back page	
	Actor Action	System Response
	1) User click "X" button.	
	2) Passenger can return to PF step 1.	
Alternative Flow (AF2)	Title: Flight not delay	
	Actor Action	System Response
	1) User click "Flights status" button	
		2) System displays notification on the flight status.
	3) User click "Confirm" button.	
	4) Passenger can return to PF step 3.	
Exception Flow (EF1)	Title: Invalid Ticket ID or last name format	
	Actor Action	System Response
	1) System detects that the Ticket ID or last name format entered is invalid.	
		2) System displays an error message.
	3) User click "Agree" button	
		3) System return passenger to PF step 3.

Table 4.2: Use Case Descriptions View Airport Map

UC Name	View real-time map	Use case description
UC #	22	Allows passengers to view a real-time map of the airport, including terminal layouts, gate locations, baggage claim areas, amenities, and other important facilities.
Primary Actor	Passenger	This helps passengers navigate the airport efficiently before boarding or after landing.
Use Case Story	This use case allows passengers to view a real-time map of their airport.	
Trigger	Passenger initiates the view real-time airport map function on their personal device upon approaching arrival or when needed at the airport.	
Pre-Condition	<ul style="list-style-type: none"> - Passenger at the airport with access to the airport map feature. - Real-time airport map system is connected to the airport's facilities information system and provides up-to-date details on gate assignments and amenities. 	
Post-Condition	<ul style="list-style-type: none"> - The airport map displays relevant facilities and updates in real-time. - The map continues to show live information as the passenger navigates the airport, 	

	updating gate changes, directions, and amenities, until they exit the feature.	
Primary Flow (PF)	Title: User is able to view real-time maps base on ticket information	
	Actor Action	System Response
	1) The user opens the "map" selection section on the main screen.	
		2) The system displays the Search information page, require user to enter Ticket ID and last name.
	3) User enter ticket ID and last name if valid, go to next step. if invalid, go to EF1.	
		4)The system displays the Location options page.
	5) The user choose an option. If user choose "Defined routes" button, go to next step. If user choose "Preferred location" button, go to AF1	
		6) The system require users' GPS permission in direction page.
	7) User respond give GPS's permission. If user allows, go to next step. If user do not allow, remain the	

	pop up until user press ""Allowed"" button.	
		8)The system displays location information in direction page
Alternative Flow (AF1)	Title: User is able to view real-time maps base on preferred location	
	Actor Action	System Response
		1) The system displays location information.
	2) User search locations	
	3) User choose locations by using "To here" button	
		4) The systems displays map.
		5) The systems require users' GPS permission.
	6) User respond give GPS's permission. If user is allowed, go to next step. If user is not allowed, return to AF1 step 4.	
		7)The system displays location information
Exception Flow (EF1)	Title: Invalid Ticket ID	
	Actor Action	System Response
	1) User entered Invalid ticket ID.	

	2) System displays an error message: "Invalid Ticket ID. Please try again."
	3) System return passenger to PF2 step 1.

4.4 Class Diagram

This class diagram models the organizational structure and operational interactions within an airline system, delineating various departments, roles, and their relationships with key entities such as passengers, flights, bookings, and payments. Each class represents a specific component or function within the airline system, capturing attributes and methods that define its responsibilities and interactions with other classes. The Passenger class is central, embodying travelers in the system. It includes attributes such as passengerID, name, email, phone, username, and password, providing personal and authentication information. The Passenger class is associated with multiple other classes, reflecting the passenger's interactions within the airline process. Key methods include bookFlight, makePayment, and checkIn, which enable passengers to perform essential actions. The TicketDepartment class oversees ticket reservations and seat assignments. With attributes such as departmentID, it contains the manageTicketReservation and assignSeat methods to handle reservations and allocate seats. The Ticket class, connected to the TicketDepartment, includes attributes like ticketID, seatNumber, and datePreferred, indicating the passenger's travel details. The FlightCrew class represents crew members with attributes like crewID and role. Its methods, operateFlight and verifyBoardingPass, indicate operational responsibilities on flights and during boarding. The Flight class represents a flight entity, with attributes for flightID, origin, destination, departureTime, and arrivalTime. It includes methods like addPassenger and removePassenger, linking passengers to specific flights. The GroundStaff class is connected to the Flight class, with the assistOperations method supporting the flight's operational needs. The Booking class represents each flight reservation with attributes for bookingID, bookingDate, and status, reflecting the reservation's specifics. It links to the Payment class, which includes attributes such as paymentID, amount, date, and paymentMethod. This association captures the transaction details associated with booking a flight. The CheckInDepartment class, associated with the Passenger class, includes methods for checkinPassenger and assignSeat, facilitating the check-in process and seat allocation for passengers. Similarly, the ConsignmentDepartment class handles handleLuggage and trackLuggage, ensuring baggage processing and tracking. The CustomsDepartment and SecurityDepartment

classes provide verification and security checks. The CustomsDepartment has a method verifyTravelDocuments, used to check passenger documents, while the SecurityDepartment, through the conductSecurityCheck method, manages passenger and baggage screening. Lastly, the BoardingPass class, which includes attributes passID, seatNumber, and flightID, signifies the passenger's assigned seat and corresponding flight information. It is closely associated with the Passenger and Flight classes, serving as a crucial element in the boarding process. This class diagram encapsulates the airline's organizational structure and the interaction of various departments, staff roles, and passenger-related entities, creating a comprehensive model of the processes involved in ticketing, flight operations, security, and passenger management. Through the methods and associations, it enables a systematic approach to handling each stage of the passenger journey, from booking and payment to boarding and in-flight operations.

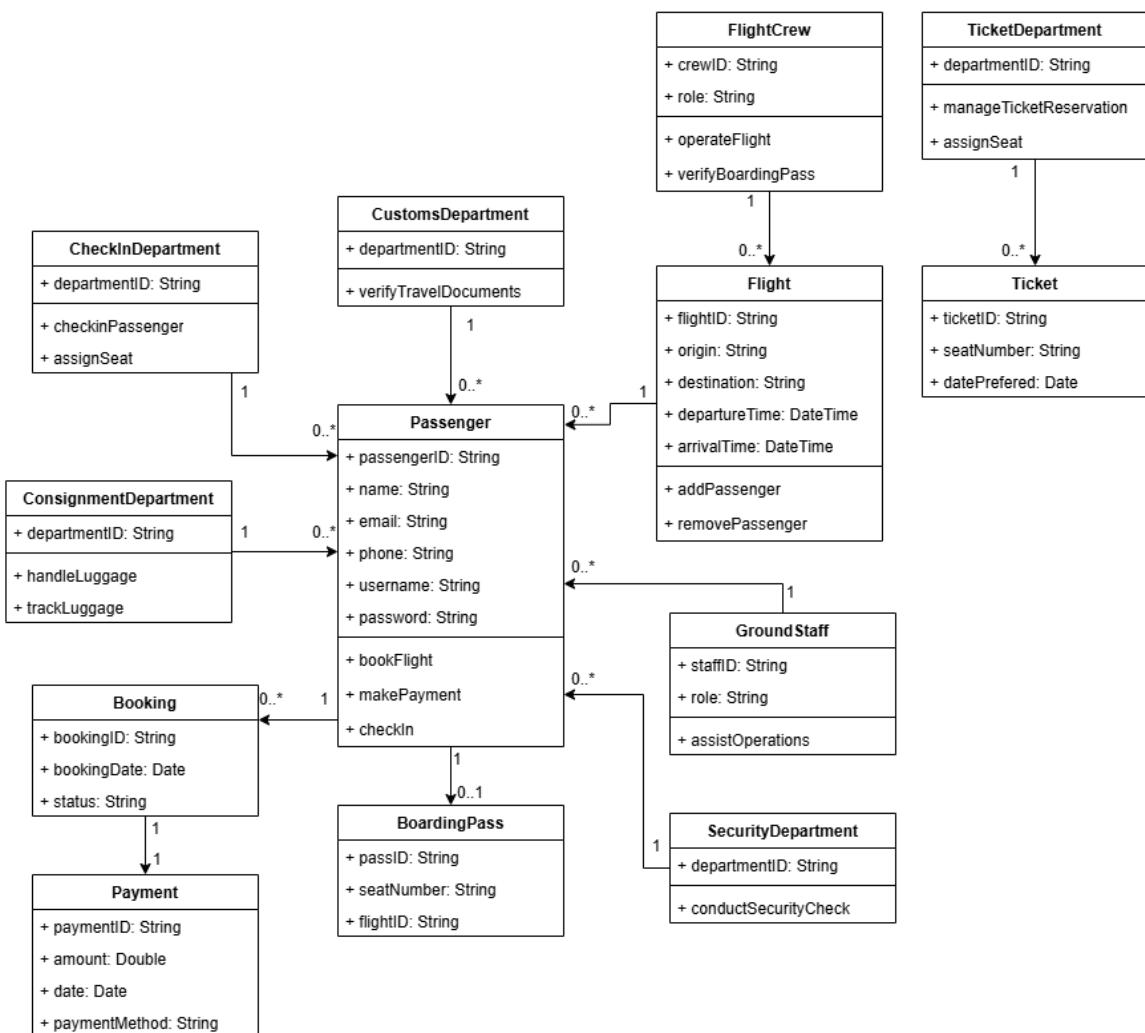


Figure 4.2: Class diagram of Vietnam Airlines

4.5 Sequence diagram

This sequence diagram illustrates the process by which a passenger accesses and interacts with airport maps through the Airport Website, with support from the Flight Management System. The interaction sequence details actions for viewing airport maps, verifying ticket information, and accessing navigation features based on ticket data. The process begins when the Passenger opens the “View airport maps” feature on the main page. The Airport Website requests the passenger’s Ticket ID to authenticate and tailor the map view based on travel details. The passenger inputs their Ticket ID and clicks the “Confirm” button, prompting the Airport Website to communicate with the Flight Management System for verification. The Flight Management System verifies the Ticket ID and sends confirmation back to the Airport Website, allowing the passenger to continue if the ID is valid. If the ticket ID is incorrect, an exception sequence (Exc 1) is triggered, notifying the passenger of the error and displaying an error message, prompting correction. Once the ticket is successfully verified, the Airport Website recommends routes based on the passenger’s flight and ticket information. The passenger can select a route to view on the map, displaying location options relevant to their journey, such as terminals and gates. The Airport Website retrieves location data from the Flight Management System to provide accurate route information. An alternative flow (Alt 1) enables the passenger to exit at any time by clicking the "Exit" button, returning them to the main View airport maps page. Another alternative flow (Alt 2) allows the passenger to request real-time navigation to specific airport locations. When this option is selected, the Airport Website provides step-by-step navigation instructions, guiding the passenger to their chosen destinations within the airport. This sequence diagram captures the interaction between system components, managing standard and alternative flows to provide navigation assistance while incorporating verification and error-handling mechanisms. This process demonstrates the integration of user inputs, system validation, and responsive features to enhance the passenger experience in navigating airport facilities.

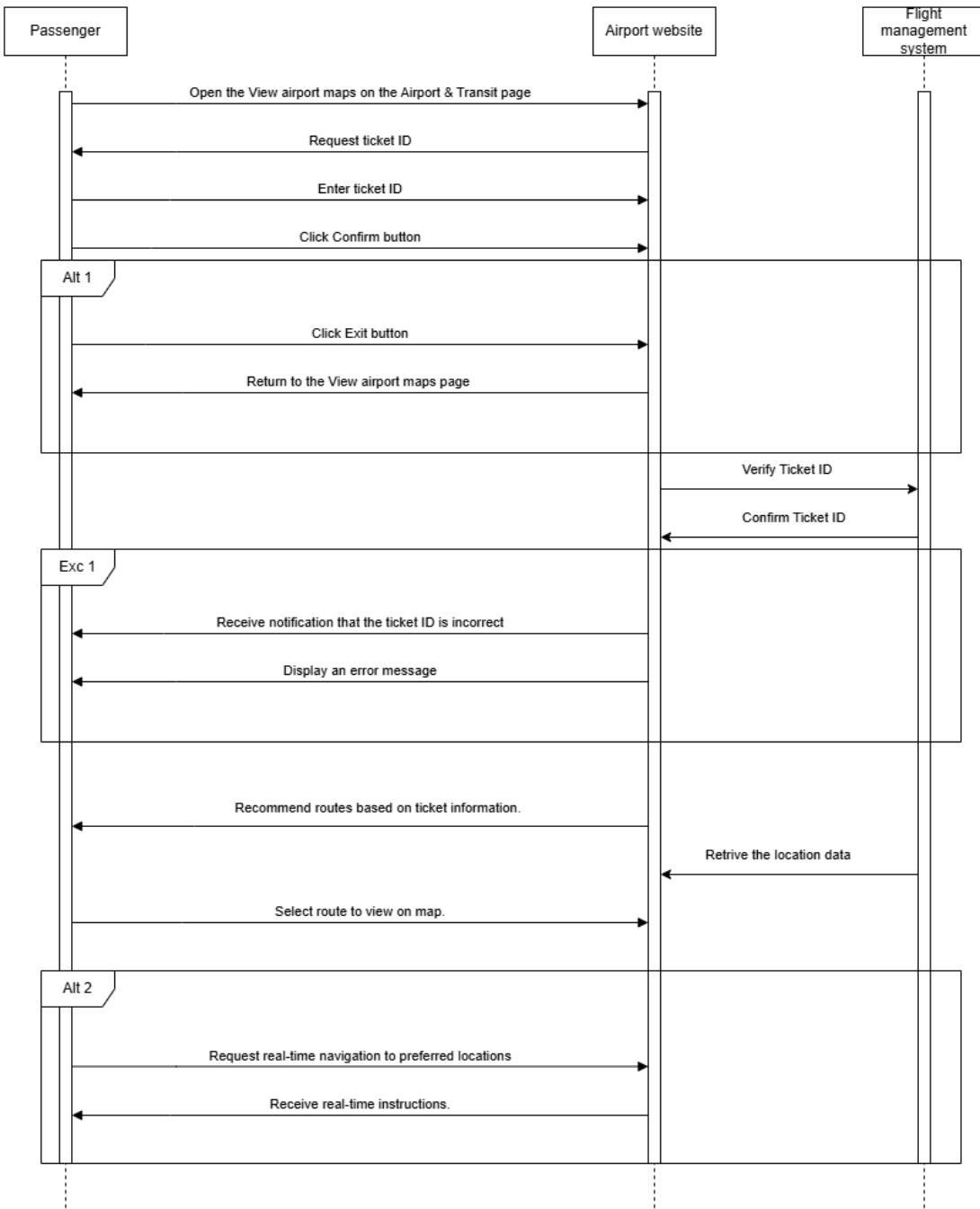


Figure 4.3: Sequence diagram - View airport map of Vietnam Airlines

This sequence diagram illustrates the process by which a passenger checks flight status and uses a voucher via the airport's Manage Booking page, facilitated by interactions between the Passenger, Airport Website, and Flight Management System. The sequence details the steps involved in verifying ticket information, retrieving flight status, and managing voucher access based on flight conditions. The process begins when the passenger opens the "Manage Booking" feature on the main page. The Airport Website prompts the passenger to enter their Ticket ID for verification. After the passenger inputs their Ticket ID and clicks the "Confirm" button, the Airport Website communicates with the Flight Management System to verify the Ticket ID. If the Ticket ID is incorrect, an exception sequence (Exc 1) is triggered, notifying the passenger of the error and prompting them to correct their input. If the Ticket ID is correct, the Airport Website receives confirmation and allows the passenger to proceed. Once verified, the Airport Website displays available manage booking services. The passenger can then choose to check the flight status. If the flight is delayed, the Airport Website notifies the passenger and proceeds to retrieve any available voucher data from the Flight Management System. The passenger can view voucher options on an aggregation screen and select a voucher to display its details. If the passenger wishes to use the voucher, they can click the "Using Voucher" button. If the flight is on schedule, an exception sequence (Exc 2) is triggered, notifying the passenger that the flight is on time and that no voucher is available due to the on-schedule status. An alternative flow (Alt 1) allows the passenger to exit the process at any point by clicking the "Exit" button, returning them to the Check Flight Status and Voucher page. If the passenger proceeds with using the voucher, the Airport Website updates the voucher's status and sends a confirmation of successful usage to the passenger, completing the transaction. This sequence diagram illustrates the interaction between system components to provide passengers with timely flight status updates and access to vouchers, while handling exceptions and alternative flows. The process exemplifies the integration of user inputs, system validation, and responsive features to improve the passenger experience in managing their travel.

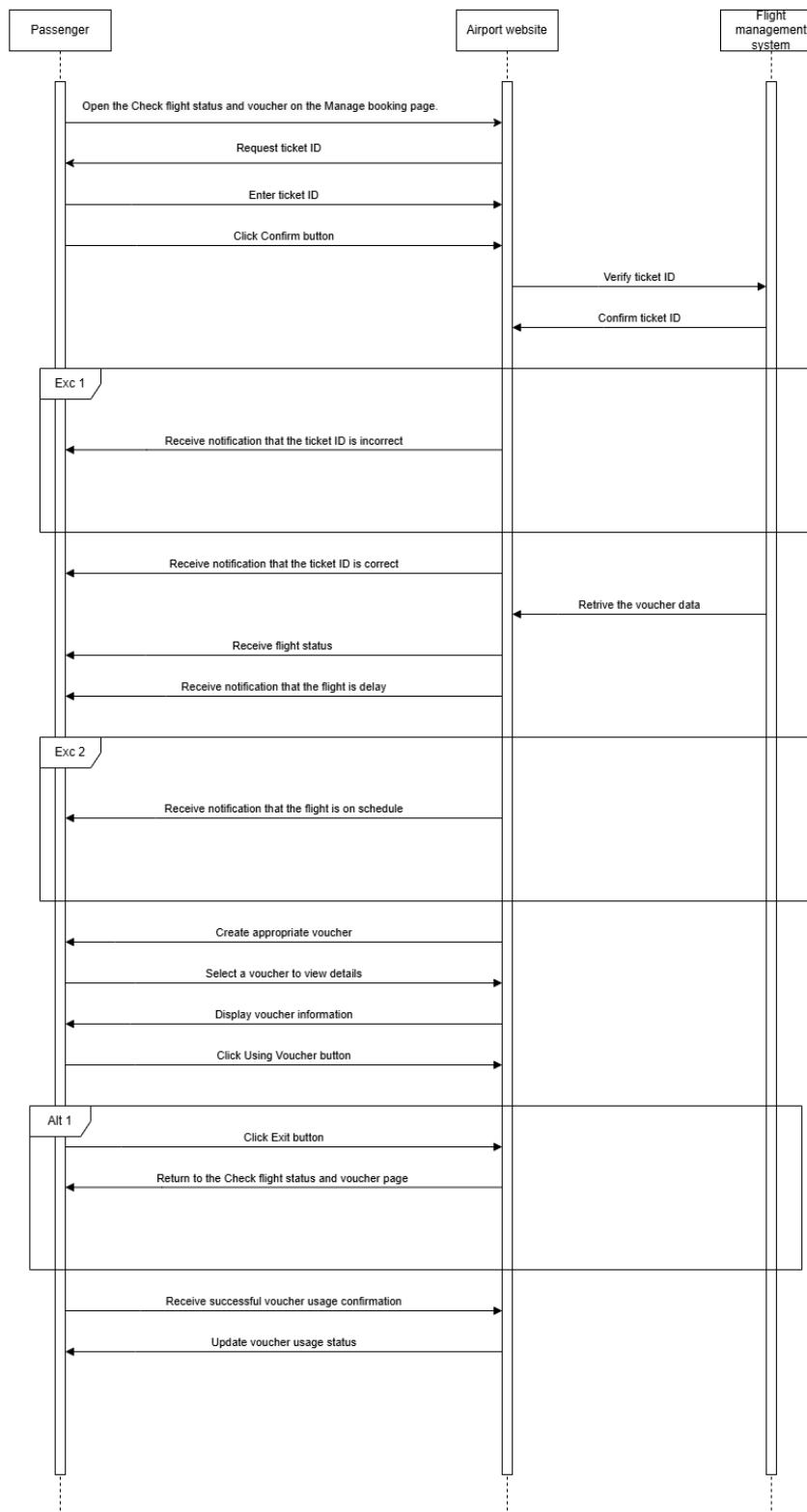


Figure 4.4: Sequence diagram - Check flight status and voucher of Vietnam Airlines

4.6 Activity Diagram

This activity diagram illustrates the "View Airport Maps" function, outlining the process flow and activities involved when a user accesses the airport map feature. The diagram provides a structured view of the steps from ticket ID verification to selecting routes or navigating to preferred locations within the airport. Two primary roles are defined in this function: the "User" and the "System," each with specific activities as follows:

The process begins with a Start Event in which the user opens the "View Airport Maps" feature on the main page.

The first step in the process is Ticket ID Request, where the system prompts the user to enter their ticket ID. This leads to the Enter Ticket ID activity, in which the user provides their ticket ID information.

Following this, the system enters the Ticket Verification phase:

- If the user has a ticket, they proceed by clicking the "Confirm" button.
- If the user does not have a ticket, they can opt to end the session by selecting the "Exit" button.

In the subsequent Ticket ID Processing stage, the system validates the ticket ID:

- If the ticket ID is correct, the system notifies the user of successful verification.
- If the ticket ID is invalid, the user receives a notification, and the system displays an error message, prompting the user to re-enter correct information.

Once ticket verification is completed, the user can proceed to Choose Preferred Locations on the map:

- If the user has no specific preferred locations, they may select a general route to view on the map.
- If the user has designated preferred locations, they can request real-time navigation to these specific destinations within the airport.

This activity diagram effectively delineates the user and system interactions required for viewing airport maps, integrating user input, verification mechanisms, and flexible options for navigation. The diagram emphasizes the systematic flow from initial access to

route selection, supported by verification and error-handling processes, to enhance the user's navigation experience within the airport.

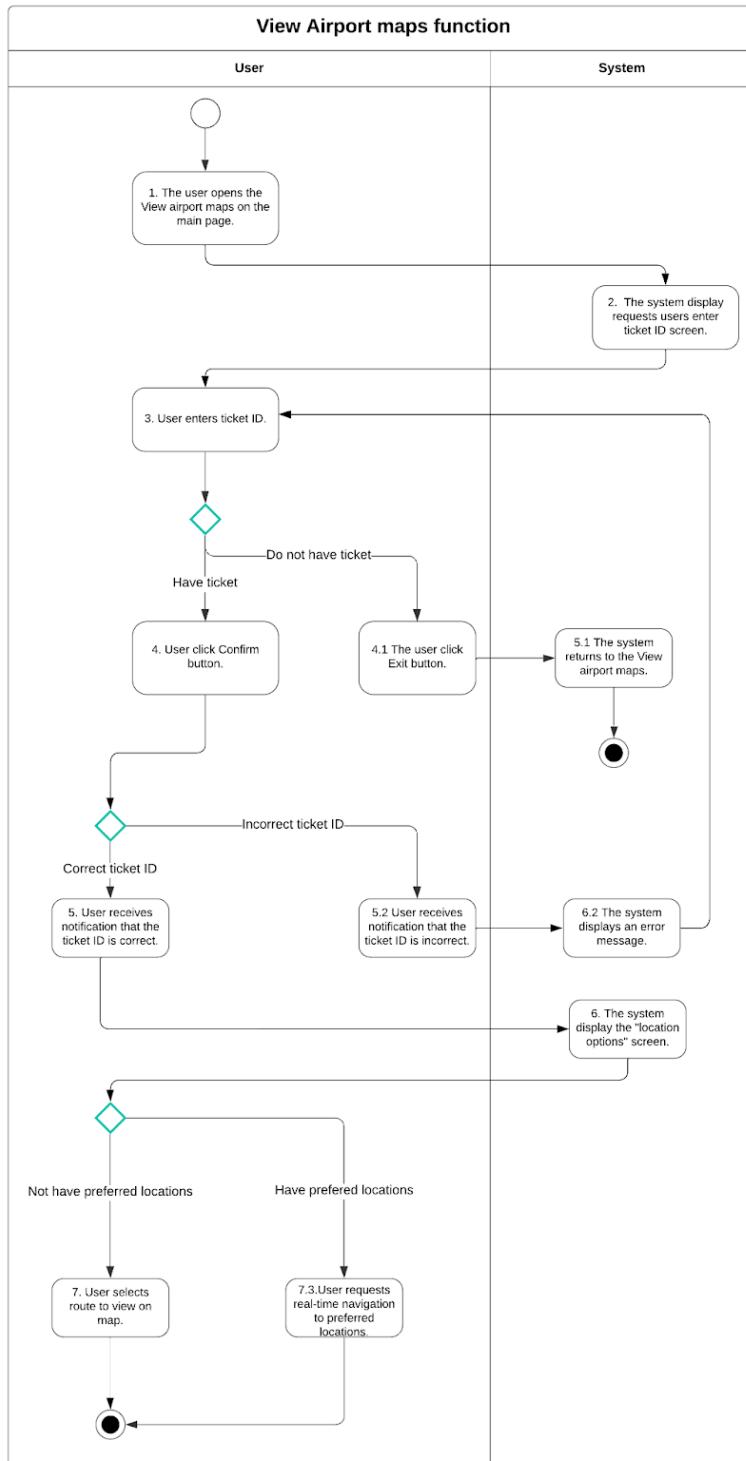


Figure 4.5: Activity Diagram – Use case View airport maps

This activity diagram outlines the "Check Flight Status and vouchers" function, detailing the sequential process flow for accessing booking management, verifying flight status, and managing vouchers for delayed flights. The diagram defines two main roles: "User" and "System," each with designated activities as follows.

The process initiates with a Start Event, where the user opens the "Manage Booking" screen. The system then proceeds with a Ticket ID Request, displaying a prompt for the user to enter their ticket ID. In response, the user performs the Enter Ticket ID activity by inputting their ticket information and subsequently selecting the Confirm Ticket ID option.

Following this, the system engages in Ticket ID Verification:

- If the ticket ID is incorrect, the user is notified of the error (6.1).
- If the ticket ID is correct, the user receives confirmation, and the system proceeds by displaying the "Manage Booking Services" screen (6, 7).

The next stage involves Check Flight Status, where the user selects the "Check Flight Status" option. At this point, the system checks for any potential flight delays:

- If there is no delay, the user is notified that the flight is on schedule (9.2).
- If a delay is detected, the system provides the user with a voucher aggregation screen, presenting potential compensatory options (9).

In the View and Use Voucher phase, the user can select a voucher to view its detailed information, which the system displays (11). At this juncture, the user has the choice to proceed or exit:

- If the user chooses not to utilize the voucher, they select the "Exit" button (12.3), returning to the "Flight Status and Delay Notifications" page (13.3).
- If the user opts to use the voucher, they click the "Use Voucher" button (12), prompting the system to confirm the voucher usage and update its usage status (13.a, 13.b).

This activity diagram effectively illustrates the interaction flow within the "Check Flight Status" function, integrating user input, system verification, and options for compensatory actions in the case of flight delays. The structured flow from initial access through to voucher management underscores the process's emphasis on user decision-

making, responsive feedback, and real-time status updates to enhance the user's experience with flight-related services.

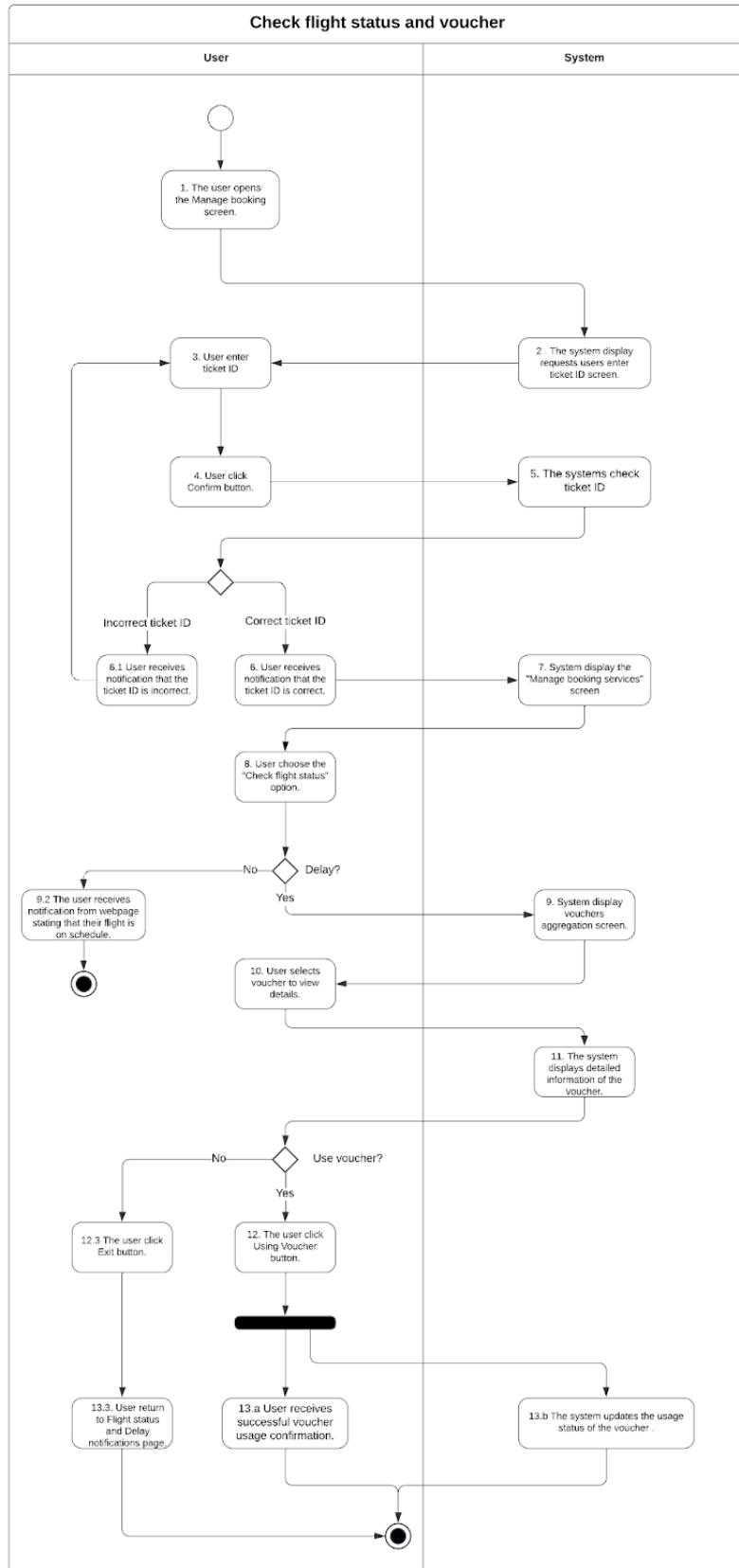


Figure 4.6: Activity Diagram – Use case Check flight status and vouchers

Part 5. User interface design and data design

5.1 User interface design

5.1.1 Overview and purposes

In this phase, our team presents the user interface design for two proposed functions mentioned in the previous section: Check Flight Status and Vouchers and View Real-Time Airport Map. Specifically, we use Figma to visualize the new interface, aiming to give readers a comprehensive understanding of our proposed functions from an UX/UI perspective.

5.1.2 Deliverables

The deliverables for this user interface design section focus on creating a cohesive and functional experience for users interacting with the Vietnam Airlines website. High-fidelity prototypes developed in Figma illustrate the layout, design, and interactive features of key functions, specifically “Check Flight Status” and “View Airport Map.” Each screen mockup, crafted using Figma, includes meticulous details regarding component placement, user navigation, and essential functionalities, along with descriptions that clarify the roles of buttons, links, and input fields. User stories and acceptance criteria outline the expected functionality of each feature to meet user needs, ensuring adherence to usability standards with field validations and logical navigation paths. The “Check Flight Status” feature allows users to verify flight details and access vouchers during delays, while the real-time map function facilitates efficient navigation within the airport. Testing protocols and clearly defined test cases ensure the functionality of both primary and alternative flows, with error messages providing guidance for users encountering validation issues

5.1.3 View Airport Maps function

5.1.3.1 User story

Table 5.1: User view real-time map

User view real-time map	
As a	User of Vietnam Airline website
I want	to be able to view real-time maps on the website

So that	I want to view the airport map so that the system can guide me to the desired locations.
Acceptance Criteria	<p>1. On the website's main screen, the system displays a "Map" hyperlink to the right of the "Shopping" link (see Figure 5.10. Homepage).</p> <p>2. When users click the "Map" hyperlink, the system navigates them to the "Search Information" page in a new window (see Figure 5.12. Search information page).</p> <p>3. On the "Search Information" page, the system prompts the user to enter their Ticket ID and last name.</p> <p>4. Upon clicking the "Search" button, the system performs the following validations:</p> <ul style="list-style-type: none"> - Ensures all required fields are entered. - Verifies Ticket ID is in a valid format. - Verifies last name is in a valid format. <p>4.1 If all validations pass, the system navigates the user to the "Location options" page (see Figure 5.15.Location options page).</p> <p>4.2 If any validation fails, the system displays inline error messages (see Table: Inline Error Messages).</p> <p>4.3 Clicking the "X" button in the upper left corner discards the entered data and returns the user to the "main" page (see Figure 5.10. Homepage).</p> <p>5. On the "Location options" page, the system displays 2 buttons to select "Defined Route" or "Go to another destination"(see Figure 5.15.Location options page).</p> <p>6. When users click "Defined Routes" or "Go to Another Destination," the system will execute the following authentications:</p> <ul style="list-style-type: none"> - If "Defined Routes" is selected, the system performs step A. - If "Go to Another Destination" is selected, the system performs step B. <p>A. Defined Routes Process</p> <p>7. The system displays the "Airport Map" along with directions with available locations (see Figure 5.17. Direction page with GPS allowance pop up).</p> <p>B. Go to Another Destination Process</p>

	<p>7. The system displays the “Airport Map” and prompts the user to enter a location.</p> <p>7.1 Clicking the “X” button in the upper left corner discards the entered data and returns the user to the main page (Vietnam Airlines website).</p> <p>8. The system displays location information based on the user’s input (See Figure 5.20. Search locations page).</p> <p>8.1 Clicking the “X” button in the upper left corner discards the entered data and returns the user to the “Airport Map.”</p> <p>9. When the user clicks “To Here,” the system displays a specific map location (See Figure 5.21. Entered Location information page).</p> <p>10. Upon clicking the “From” box, the system prompts with the message “Allow ‘Maps’ to access your location.” (See Figure 5.23. Choose current location page and Figure 5.25. “Maps” notification)</p> <p>10.1 If the user selects “Allow,” the system displays directions based on the user’s location.</p> <p>10.2 If the user selects “Don’t Allow,” the system returns to the step by clicking the “From” box. (Figure 5.23. Choose current location page)</p> <p>10.3 Clicking the “X” button in the upper left corner discards the entered data and returns the user to the previous page (step 7).</p> <p>11. The system displays directions location (See Figure 5.27. Direction page (Go to passengers’ preferred locations)).</p>
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5.1.3.2 Screen Mockups

View Airport Maps – Use case 22

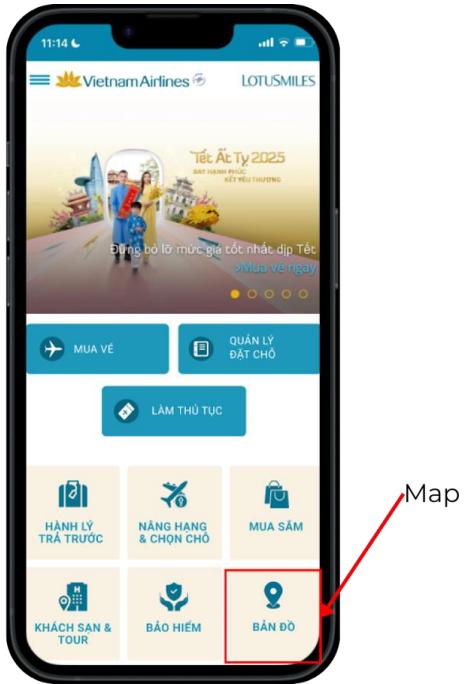


Figure 5.1: UC22_Mockup description_Homepage

Table 5. 2: "Map" button description

No.	New components	Meaning
1	“Map” button	This button supports passengers find their ways.

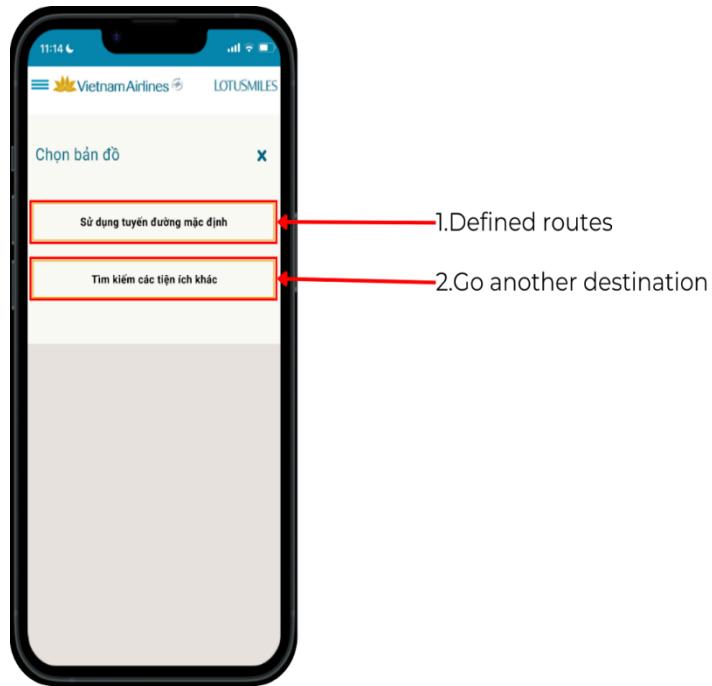


Figure 5.2: UC22_Mockup description_Choose map page

Table 5.3: “Bản đồ” button description

No.	New components	Meaning
1	“Defined routes” button	This button for passengers find their ways based on their ticket information.
2	“Go another destination” button	This button for passengers find ways to their preferred destination.

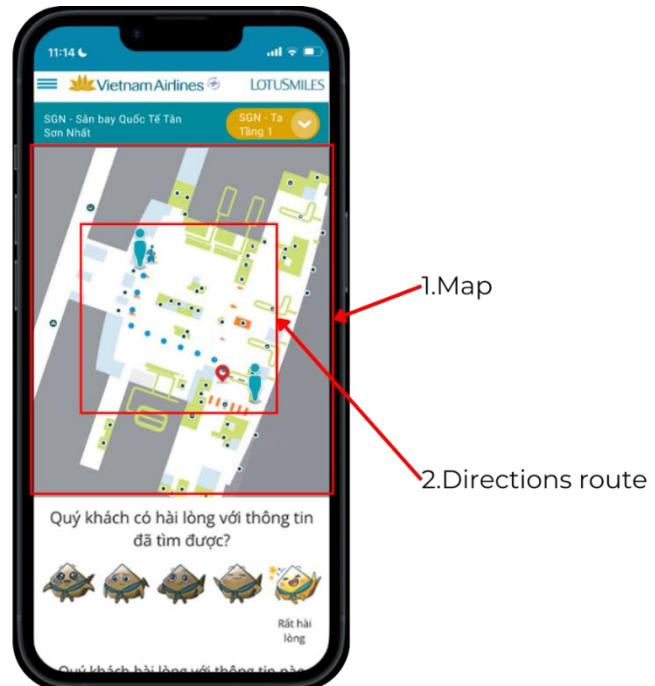


Figure 5.3: UC22_Mockup description_Direction page (Defined routes)

Table 5.4: Defined routes page description

No.	New components	Meaning
1	“Map” area	This is a defined airport maps.
2	“Direction route” area	This area is created based on their current location and ticket information.

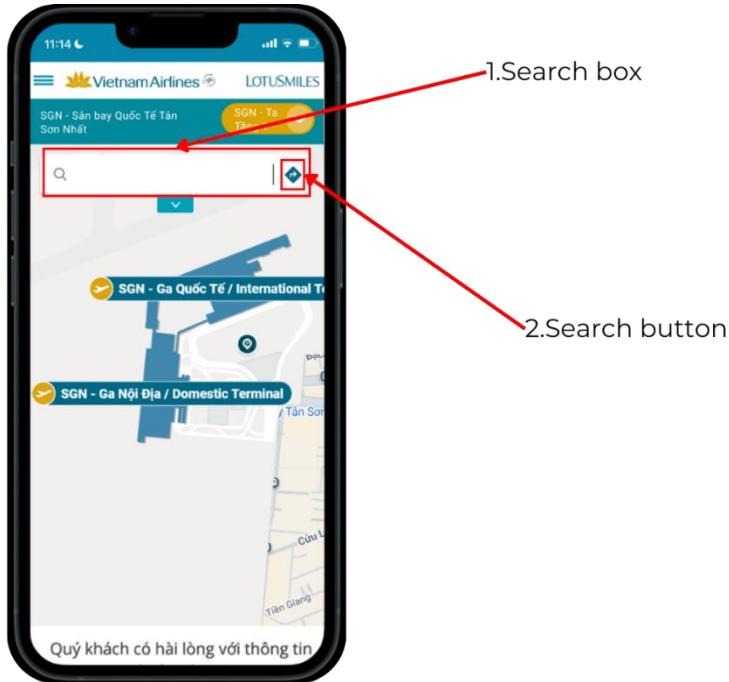


Figure 5.4: UC22_Mockup description_Search locations page

Table 5.5: Search locations page description

No.	New components	Meaning
1	“Search” box	This box is for passengers to enter their destination.
2	“Search” button	This button is for passengers to search their destination.

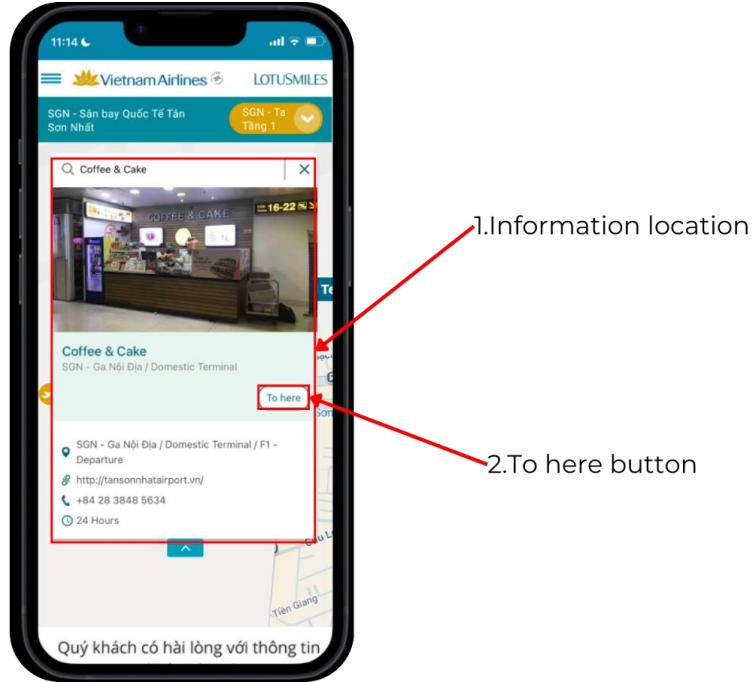


Figure 5.5: UC22_Mockup description_Information location page

Table 5.6: Information location page description

No.	New components	Meaning
1	“Information location” box	This box is for passengers to find information about the location destination.
2	“To here” button	This button is for passengers to confirm their destination.

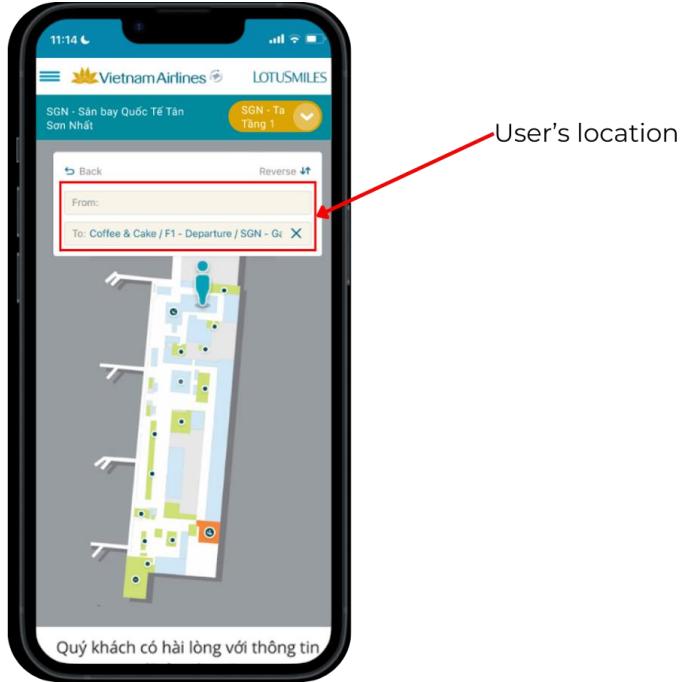


Figure 5.6: UC22_Mockup description_Enter user's location

Table 5.7: Enter user's location page description

No.	New components	Meaning
1	“User’s location” box	This box is for passengers to enter their location.

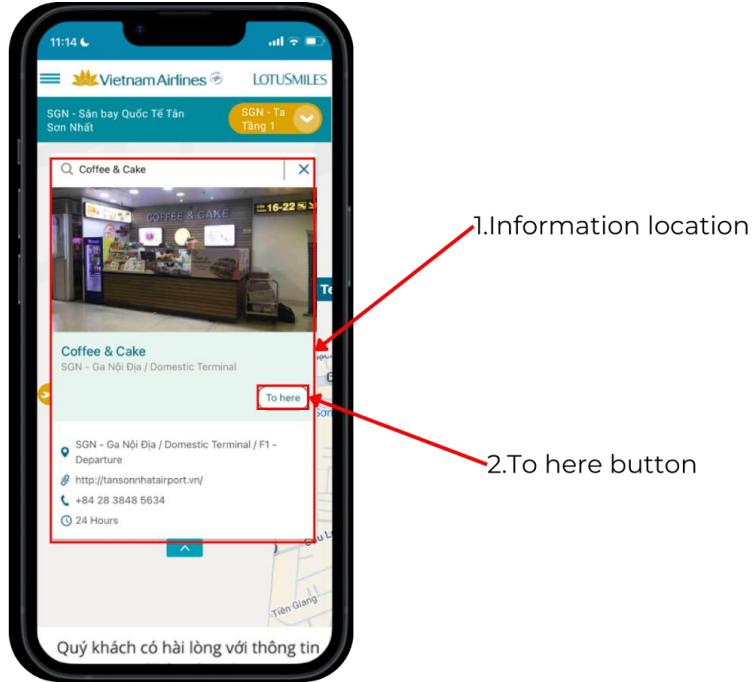


Figure 5.7: : UC22_Mockup description_Confirm location

Table 5.8: Information location page description

No.	New components	Meaning
1	“Information location” box	This box is for passengers to find information about the location destination.
2	“To here” button	This button is for passengers to confirm their destination.

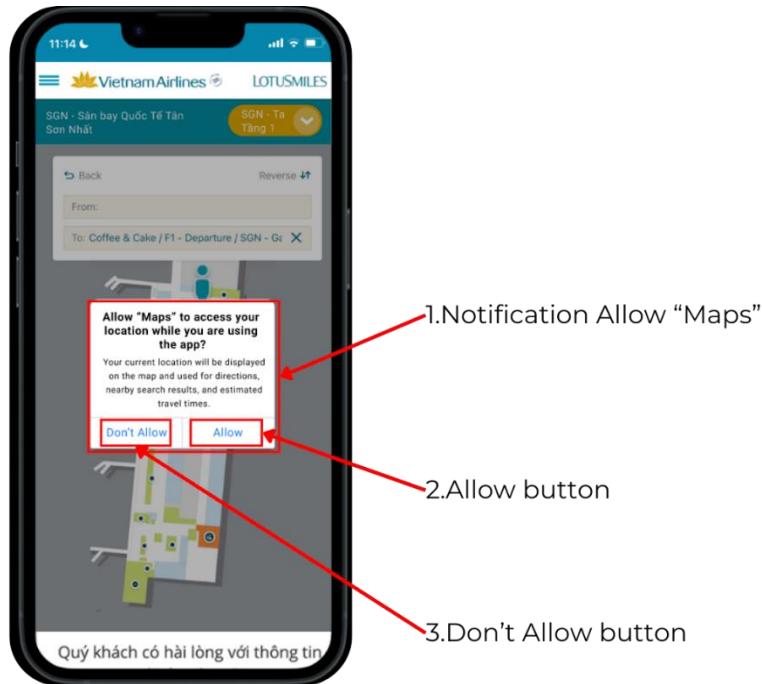


Figure 5.8: UC22_Mockup description_Allow ‘Maps’ notificaton

Table 5.9: Allow ‘Maps’ notificaton page description

No.	New components	Meaning
1	Notification Allow ‘Maps’	This notice is for passengers to understand the rights required by the system.
2	“Allow” button	This button is for passengers to confirm granting permissions to the system.
3	“Don’t Allow” button	This button is for passengers to confirm denying permissions to the system.

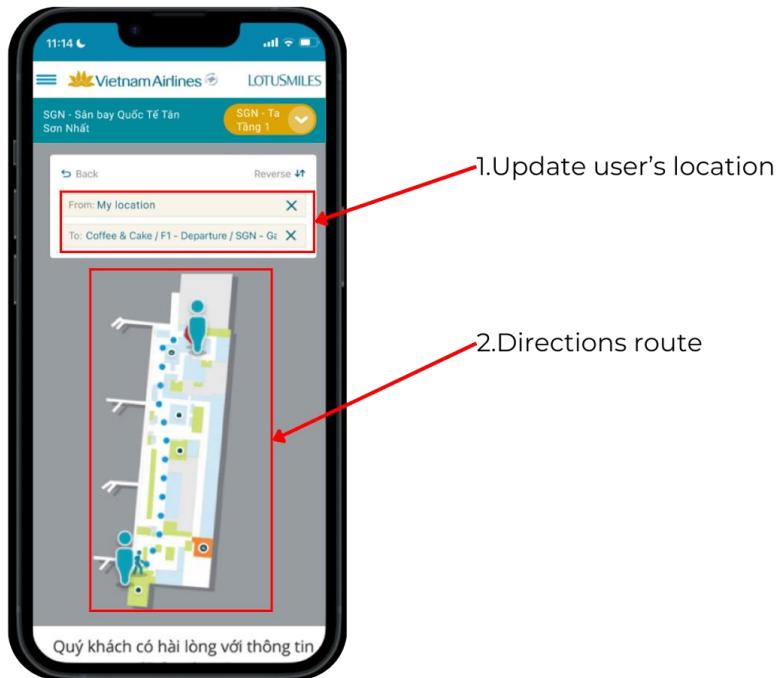


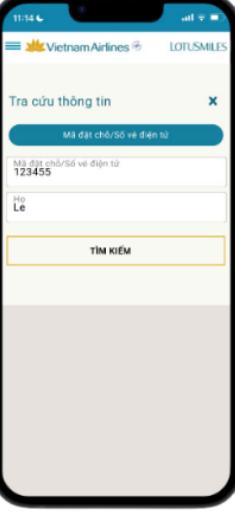
Figure 5.9: UC22_Mockup description_Direction page (Go to the another)

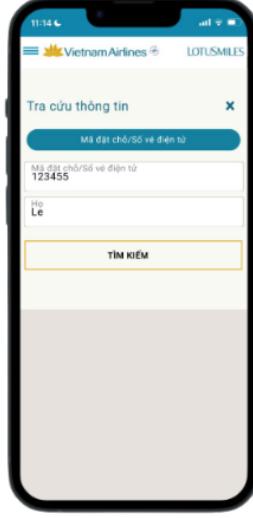
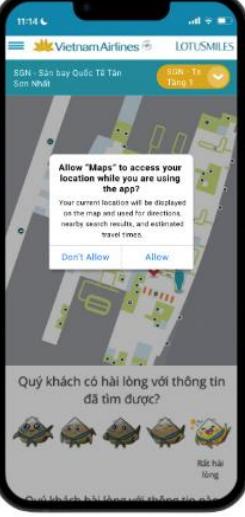
Table 5.10: Direction page description

No.	New components	Meaning
1	Update user's location box	This box is for passengers to search the location destination.
2	“Direction route” area	This area is created based on their current location and their preferred location.

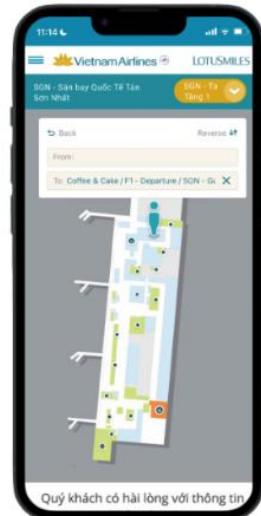
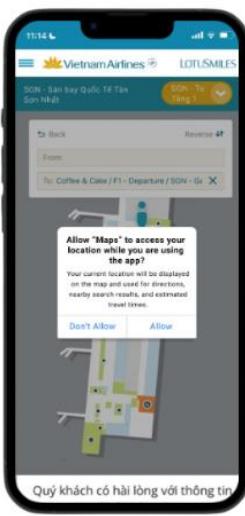
5.1.3.3 Prototype

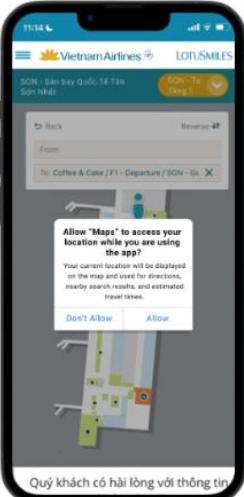
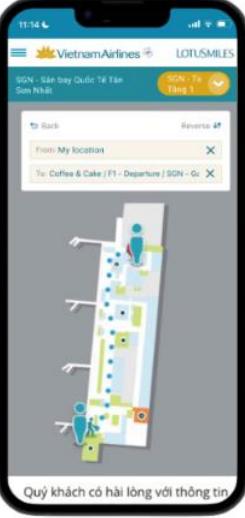
Table 5.11: Test case for View Airport Maps function

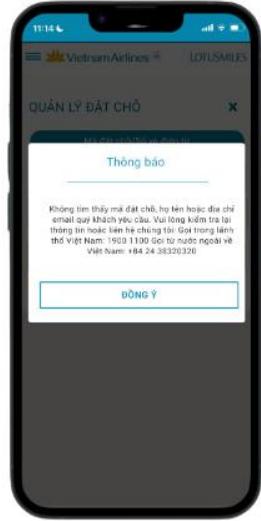
Flow	Page name	Input	Output
Primary flow - User checks flight status and retrieves vouchers after delay	 <i>Figure 5.10: Homepage</i>	Click on the "Map" button to display the "Look up information" page.	 <i>Figure 5.11: Search information page</i>
	 <i>Figure 5.12: Search information page</i>	User enter “Ticket ID”.	 <i>Figure 5. 13: Passenger enter information screenshot</i>

	 <p><i>Figure 5.14: Passenger enter information screenshot</i></p>	<p>If valid ticket ID, The system displays the Location options screen. if invalid ticket ID, go to EF1</p>	 <p><i>Figure 5.15: Location options page</i></p>
	 <p><i>Figure 5.16: Location options page</i></p>	<p>The user choose an option. If user choose "Defined routes" button, the system displays location information.. If user choose "Preferred location" button, go to AF1</p>	 <p><i>Figure 5. 17: Direction page with GPS allowance pop up</i></p>

<p>Alternative flow 1 - User is able to view real-time maps base on preferred location</p>		<p>User choose "Preferred location" button. The system displays location information.</p>	
		<p>User search locations.</p>	

	 <p><i>Figure 5.22: Entered Location information page</i></p>	<p>User choose locations by using "To here" button. Then The systems displays the map.</p>	 <p><i>Figure 5.23: Choose current location page</i></p>
	 <p><i>Figure 5.24: Choose current location page</i></p>	<p>Select the "To" box to select the location. The system requires users' GPS permission.</p>	 <p><i>Figure 5.25: "Maps" notification</i></p>

	 <p><i>Figure 5.26: "Maps" notification</i></p>	<p>If user is allowed, go to next step.</p> <p>If user is not allowed, remain the pop up until user press "Allowed" button.</p>	 <p><i>Figure 5.27: Direction page (Go to passengers' preferred locations)</i></p>
Alternative flow 2 - User enter ticket ID	 <p><i>Figure 5.28: Search information page</i></p>	<p>After entering Invalid ticket ID. System displays an error message: "Invalid Ticket ID. Please try again."</p>	 <p><i>Figure 5.29: Pop-up error message page</i></p>

		<p>User click “Agree” button then the system return user to “Looking up information” page.</p>	
<p><i>Figure 5.30: Pop-up error message page</i></p> <p><i>Figure 5.31: Search information page</i></p>			

5.1.4 Check flight status and voucher function

5.1.4.1 User story

Table 5.12: User Check flight status and vouchers

User Check flight status and vouchers	
As a	User of Vietnam Airline website
I want	to be able to check flight status and voucher on the website
So that	I want to view flight status information as well as how to use the voucher.
Acceptance Criteria	<ol style="list-style-type: none"> On the main screen of the website, the system will display a “Manage Booking” hyperlink positioned to the right of the “Buy Ticket” hyperlink (see Figure 5.44. Booking management). The system will allow the user to enter the ticket ID and last name (See Figure 5.45. Booking management). Upon clicking the “Search” button, the system will perform the following validations: <ul style="list-style-type: none"> - All required fields are entered. - Ticket ID is in a valid format.

	<ul style="list-style-type: none"> - Last name is in a valid format. <p>3.1 If all validations are successful, the system will navigate the user to the next page has a “Flight Status” button.</p> <p>3.2 If any validation fails, the system will display inline error messages (see Table: Inline Error Messages).</p> <p>3.3 Upon clicking the “X” button in the upper left corner, the system will discard the entered data and return the user to the main page (See Figure 5.43. Home page).</p> <p>4. Upon clicking the “Check flight status” hyperlink, the system will navigate the user to the “Check flight status” page in a new screen window. (See Figure 5.46. Manage Booking).</p> <p>5. The system displays the flight status.</p> <p>5.1 If the flight is not delayed, the system will display a message: “Flight not recorded as delayed.” (See Figure 5.64. Notification record not delay flight page)</p> <p>5.2 If the flight is delayed, the system will display a message. (See Figure 5.48. Notification record delay flight page)</p> <p>5.3 Upon clicking the “X” button in the upper left corner, the system will return the user to the “Manage Booking” page (Step 4).</p> <p>6. The user can confirm the message or view voucher details.</p> <p>6.1 If the flight is not delayed, the user clicks the “Confirm” button to return to the “Manage Booking” page. (See Figure 5.64. Notification record not delay flight page)</p> <p>6.1.1 Upon clicking the “X” button in the upper left corner, the system will return the user to the “Manage Booking” page (Step 4).</p> <p>6.2 If the flight is delayed, the user clicks the “View Voucher” button, and the system will display the “View Voucher” page. (See Figure 5.49. Notification record delay flight page).</p> <p>6.2.1 Upon clicking the “X” button in the upper left corner, the system will return the user to the “Flight status and Delay notifications” page (Step 5).</p> <p>7. The system displays a list of E-voucher (See Figure 5.50. List E-Voucher of each types service page):</p>
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	<p>7.1 When users select "Food & Drink," the system displays E-vouchers specific to Food & Drink. (See Figure 5.52. E-voucher Food & Drink)</p> <p>7.2 When users select "Flight Ticket Promotion" the system displays E-vouchers for flight ticket promotions. (See Figure 5.53. E-voucher for Airline ticket discount)</p> <p>7.3 When users select "Accommodation" the system displays E-vouchers for accommodations. (See Figure 5.54. E-voucher for free Accommodation)</p> <p>7.4 Upon clicking the “X” button in the upper left corner, the system will return the user to the “Flight status” page (Step 5).</p> <p>8. Users select the vouchers they wish to redeem.</p> <p>9. The system displays a QR code for the selected E-voucher, allowing users to redeem it directly with participating providers. (See Figure 5.56. Food& Drink E-voucher detail information, Figure 5.57. E-voucher for Airline ticket discount and Figure 5.58. E-voucher for free Accommodation)</p> <p>9.1 Upon clicking the “X” button in the upper left corner, the system will return the user to the “list of E-voucher” page (Step 7).</p>
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5.1.4.2 Screen Mockups

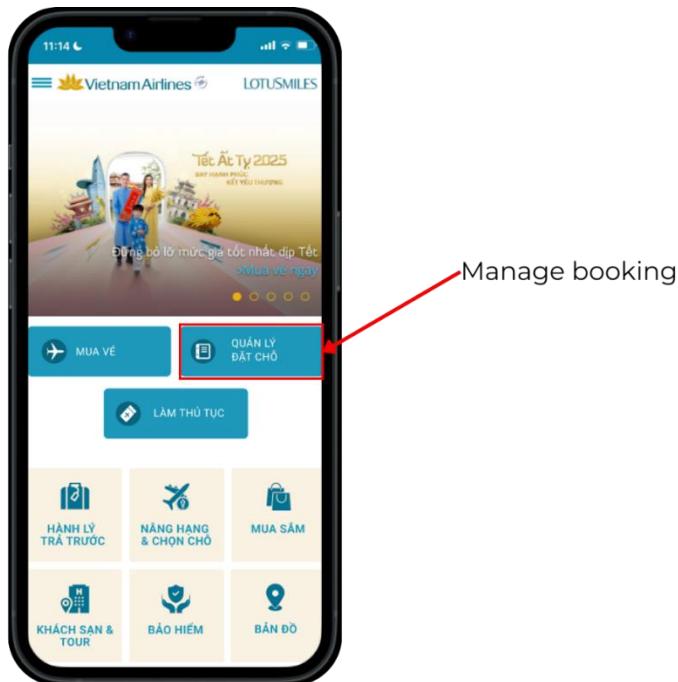


Figure 5.32: UC17_Mockup description_Homepage

Table 5.13: “Manage booking” button description

No.	New components	Meaning
1	“Manage booking” button	This button supports passengers manage booking.

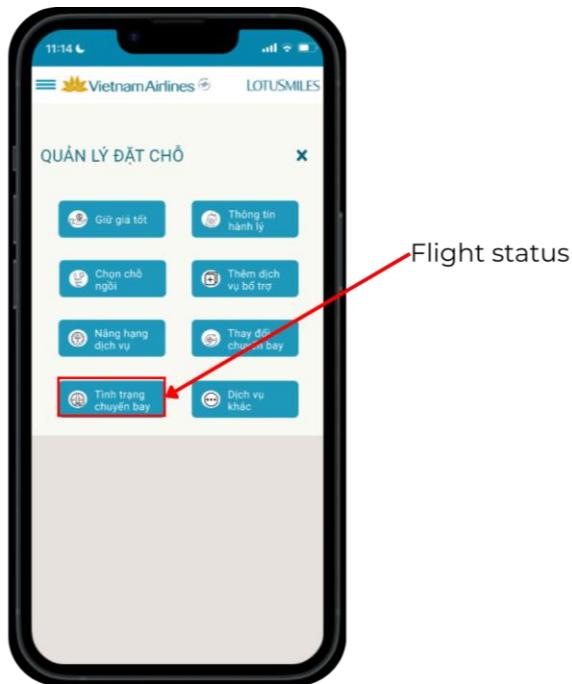


Figure 5.33: UC17_Mockup description_Flight status button

Table 5.14: “Flight status” button description

No.	New components	Meaning
1	“Flight status” button	This button supports passengers checking flight status.

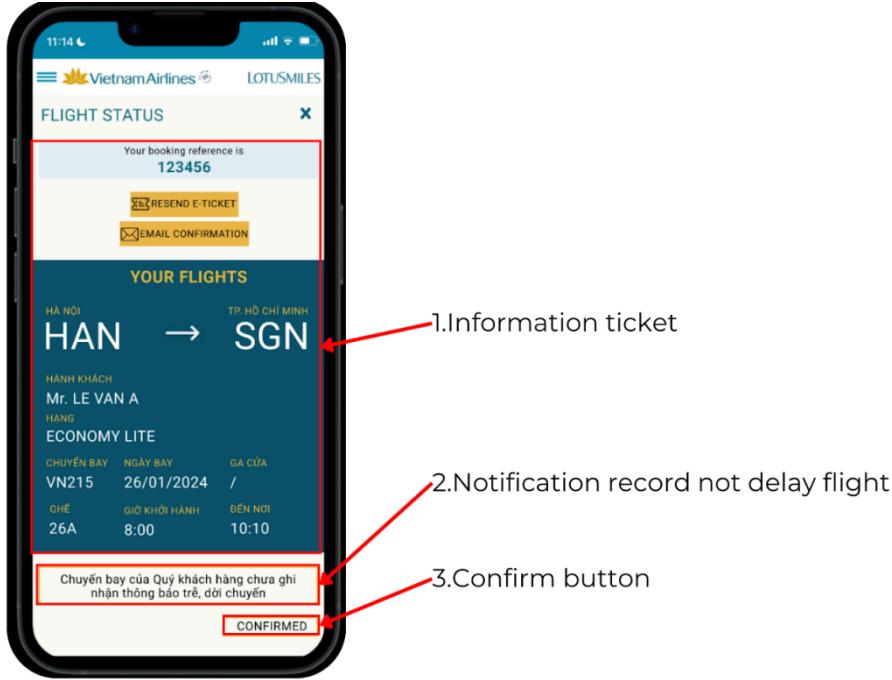


Figure 5.34: UC17_Mockup description_Notation record not delay flight page

Table 5.15: Notification record not delay flight page description

No.	New components	Meaning
1	Information ticket box	This box is for passengers to view ticket information.
2	Notification record not delay flight	This notice is for passengers to confirm that the flight has not been delayed.
3	“Confirm” button	This button is for passengers to confirm the flight status information.

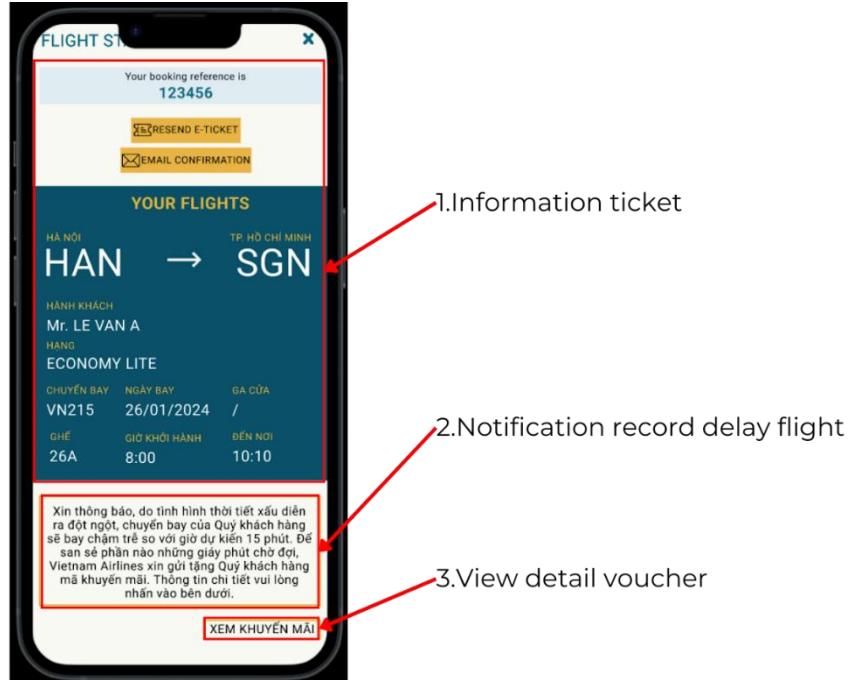


Figure 5.35: UC17_Mockup description_Notation record delay flight page

Table 5.16: Notification record delay flight page description

No.	New components	Meaning
1	Information ticket box	This box is for passengers to view ticket information.
2	Notification record delay flight	This notice is for passengers to confirm that the flight has been delayed.
3	“View detail voucher” button	This button is for passengers to view voucher details.

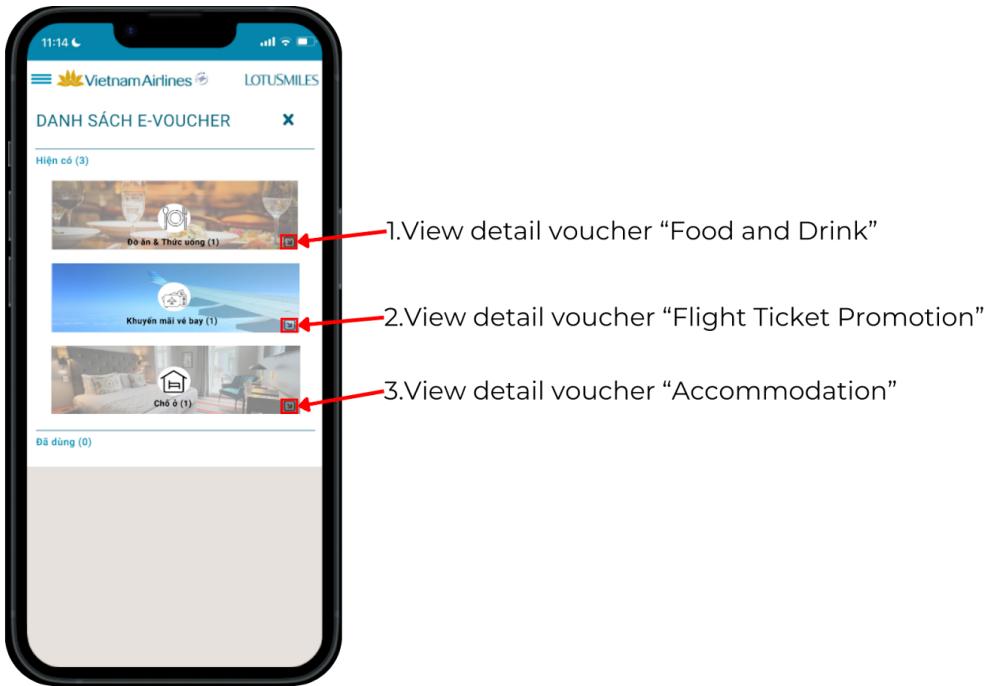


Figure 5.36: UC17_Mockup description_List E-Voucher

Table 5.17: List E-Voucher page description

No.	New components	Meaning
1	Food & Drink	This button is for passengers to view voucher details Food & Drink.
2	Flight Ticket Promotion	This button is for passengers to view voucher details Flight Ticket Promotion.
3	Accommodation	This button is for passengers to view voucher details Accommodation.

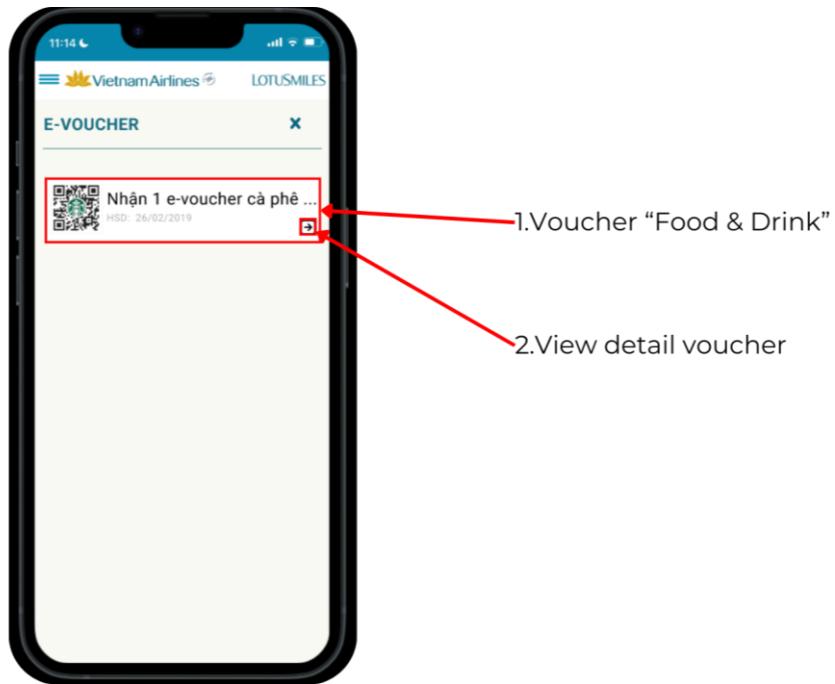


Figure 5.37: UC17_Mockup description_E-Voucher Food & Drink

Table 5.18: E-Voucher Food & Drink page description

No.	New components	Meaning
1	Voucher Food & Drink	This is for passengers to view available Food & Drink vouchers.
2	View detail voucher	This is for passengers to view detail Food & Drink vouchers.

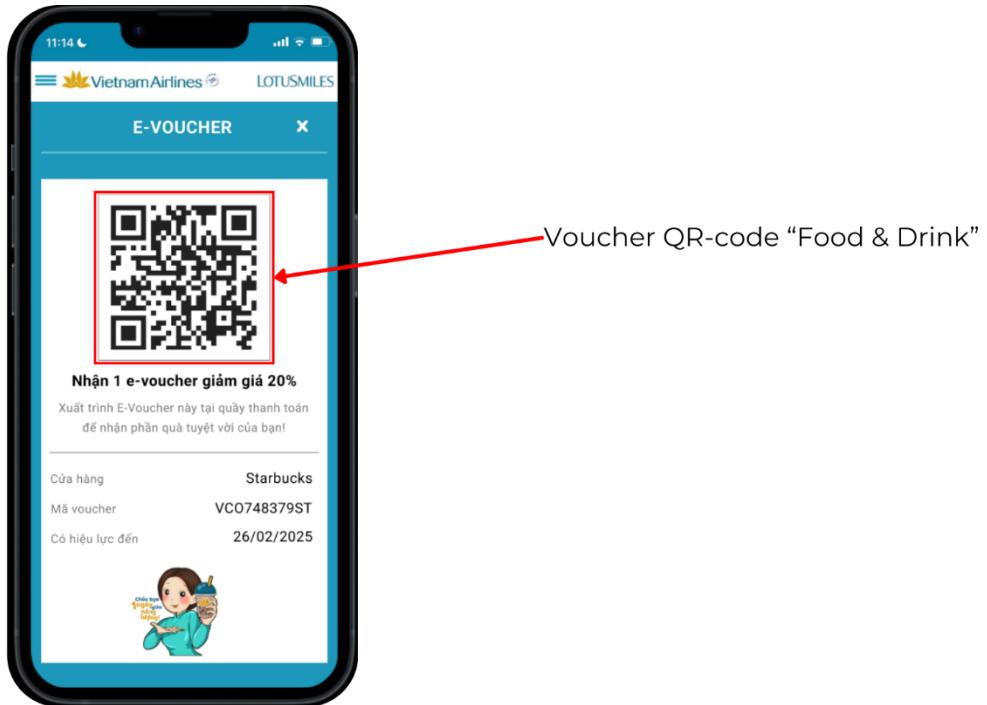


Figure 5.38: UC17_Mockup description_ Voucher Food & Drink detail information

Table 5.19: E-Voucher Food & Drink page description

No.	New components	Meaning
1	Voucher Food & Drink	This allows passengers to use Flight Ticket Promotion.

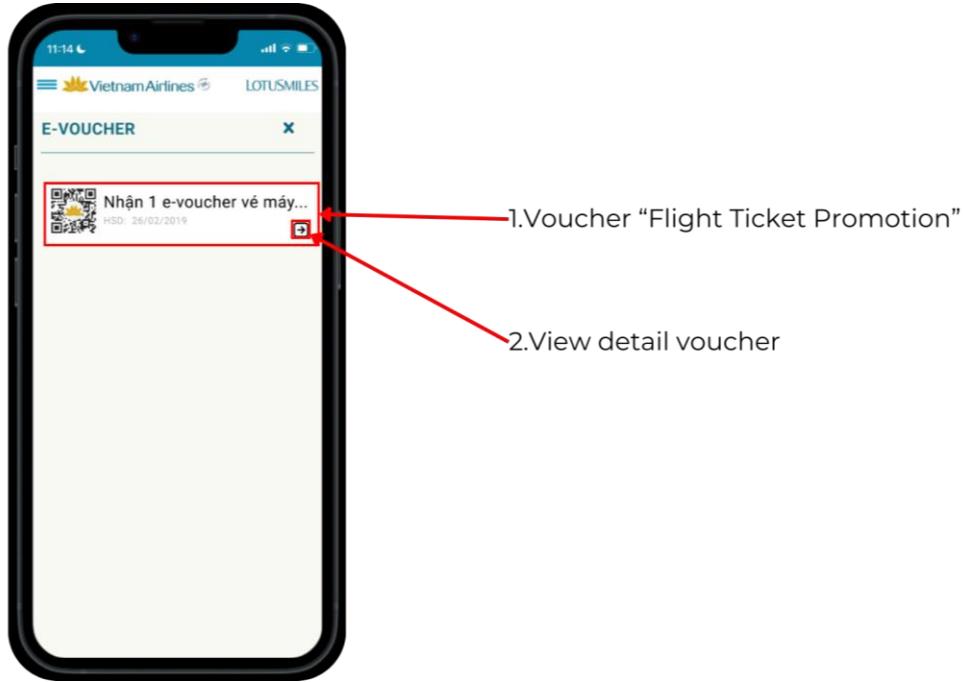


Figure 5.39: UC17_Mockup description_E_Voucher flight ticket promotion detail information

Table 5.20: E-Voucher flight ticket promotion description

No.	New components	Meaning
1	Voucher QR-code flight ticket promotion.	This is for passengers to view available flight ticket promotions.
2	View detail voucher	This is for passengers to view detail flight ticket promotion vouchers.

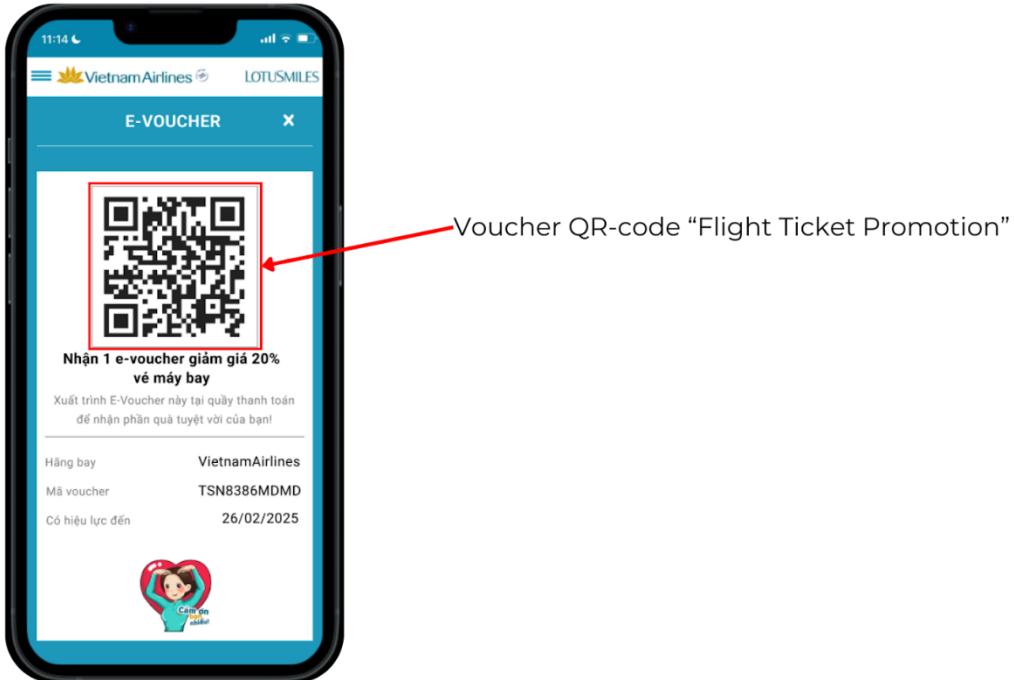


Figure 5.40: UC17_Mockup description_Voucher flight ticket promotion detail information

Table 5.21: E-Voucher Flight Ticket Promotion description

No.	New components	Meaning
1	Voucher Flight Ticket Promotion	This allows passengers to use Flight Ticket Promotion.

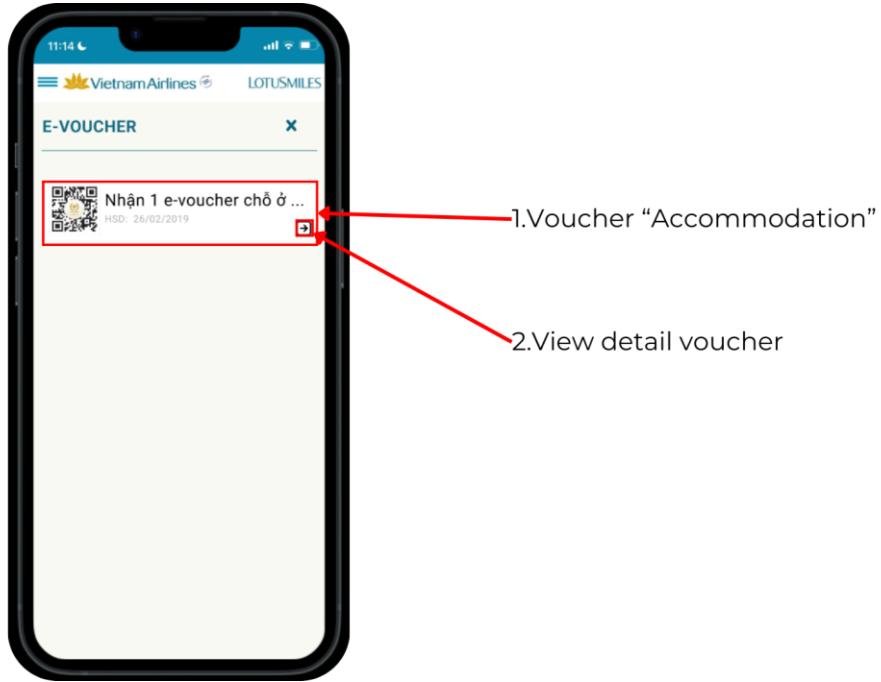


Figure 5.41: UC17_Mockup description_E-Voucher Accommodation

Table 5.22: E-Voucher Accommodation description

No.	New components	Meaning
1	Voucher Accommodation	This is for passengers to view available Accommodation vouchers.
2	View detail voucher	This is for passengers to view detail Accommodation vouchers.

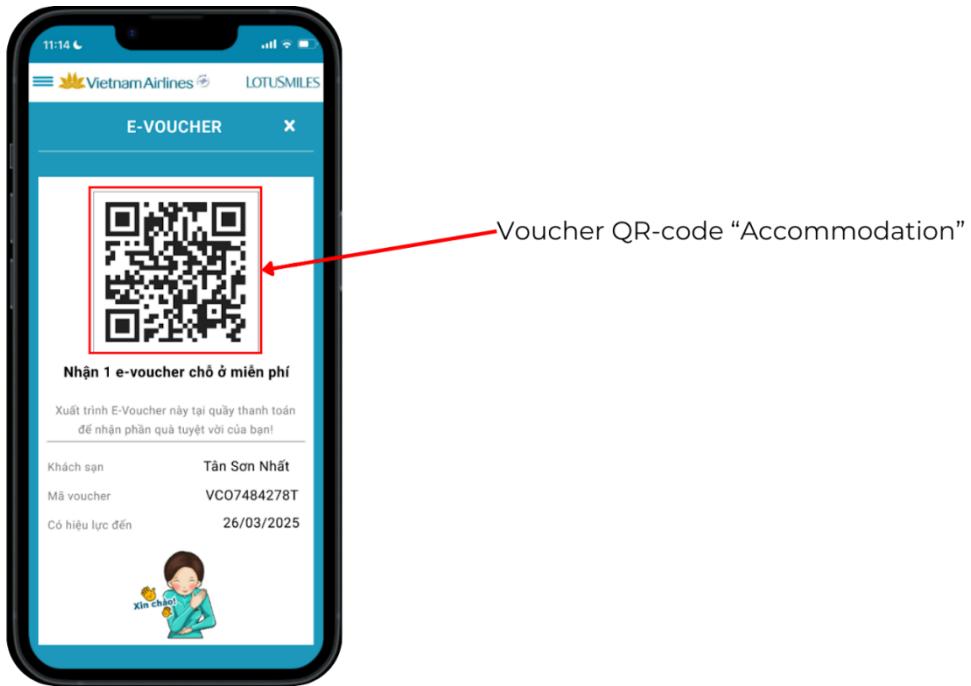


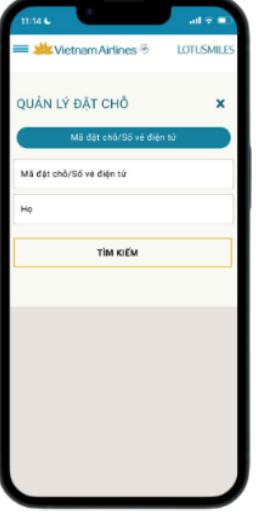
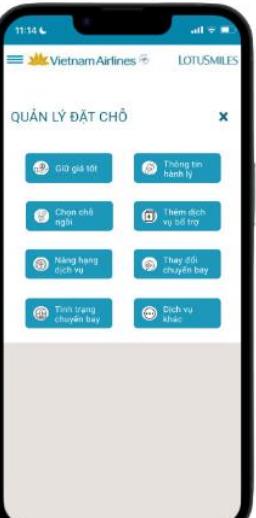
Figure 5.42: UC17_Mockup description_Voucher Accommodation detail information

Table 5.23: E-Voucher Accommodation description

No.	New components	Meaning
1	Voucher Accommodation	This allows passengers to use Accommodation vouchers.

5.1.4.3 Prototype

Table 5.24: Test case for Check flight status and voucher function

Flow	Page name	Input	Output
Primary flow - User checks flight status and retrieves vouchers after delay	 <p>Figure 5. 43: Homepage</p>	User clicks the “Manage Booking” hyperlink to go to the “Booking management” page. If user want to return to the HomePage, go to step AF1.	 <p>Figure 5. 44: Booking management</p>
	 <p>Figure 5. 45: Booking management</p>	Enter “Ticket ID” and “Last name” to check the information. If the information is correct, go to “Manage Booking” page, if not, go to step EF1.	 <p>Figure 5. 46: Manage Booking</p>

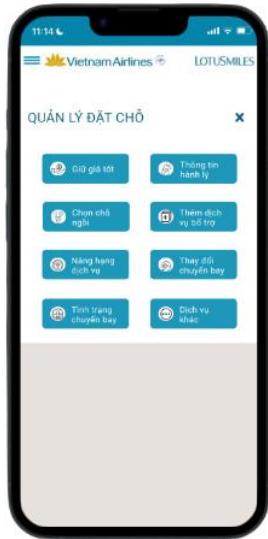


Figure 5.47: Manage booking

User clicks "Flights status" button. If delay , display delay notification page. If no delay, go to AF2.



Figure 5.48:
Notification record
delay flight page



Figure 5.49:
Notification record
delay flight page

User click "View detail Voucher" button. System displays List E-Voucher page.



Figure 5.50: List E-Voucher of each types service page



Figure 5.51: . List E-Voucher of each types service

Users select the vouchers they wish to redeem. System displays List E-Voucher page.



Figure 5.52: E-voucher Food & Drink

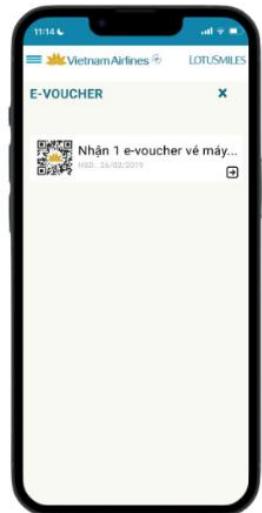


Figure 5.53: E-voucher for Airline ticket discount



Figure 5.54: E-voucher for Airline ticket discount

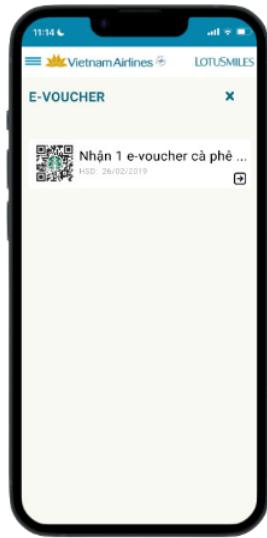


Figure 5.55: E-voucher Food & Drink

User clicks arrow button to open the system which displays information for each type of voucher.



Figure 5.58: Food& Drink E-voucher detail information

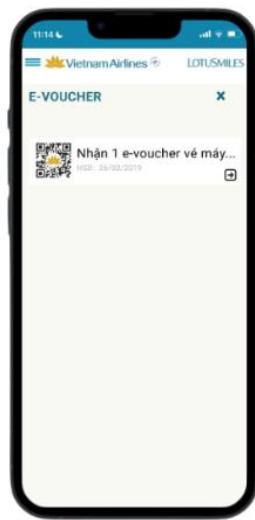


Figure 5.56: E-voucher for Airline ticket discount



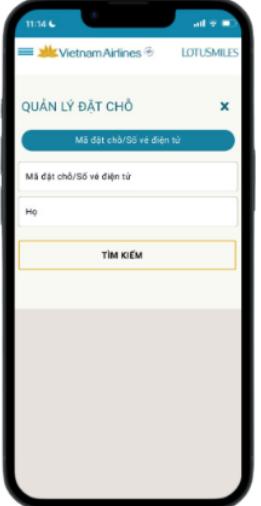
Figure 5.59: Flight discount E-voucher detail information



Figure 5.57: E-voucher for free Accommodation



Figure 5.60: Free Accommodation E-voucher detail information

<p>Alternative flow 1 - Back page</p>		<p>User click "X" button. System returns user to Homepage</p>	
<p>Alternative flow 2 - Flight not delay</p>		<p>User click "Flights status" button. System displays notification on the flight status.</p>	

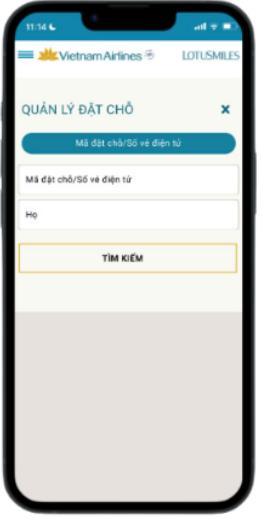
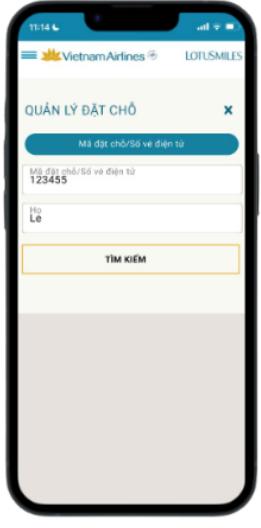
	 <p><i>Figure 5.65: Notification record not delay flight page</i></p>	<p>User click "Confirm" button. System returns user to “Booking management” page.</p>	 <p><i>Figure 5.66: Booking management</i></p>
Exception Flow 1 - Invalid Ticket ID or last name format	 <p><i>Figure 5.67: Booking management</i></p>	<p>After enter invalid “Ticket ID” and “Last name”, click on “Find” button. The system displays an error message.</p>	 <p><i>Figure 5.68: Pop-up error message</i></p>



Figure 5.69: Pop-up error message

User click "Agree" button. System displays a “Booking management” page again.



Figure 5.70: Booking management

5.2 Validation

Table 5.25: *Inline Error Messages*

Failed Validation	Error Message Displayed
All required data is entered	<Data Field Name> is a required data.
Ticket ID is in a valid format	Please enter a valid email address.
Lastname is in a valid format	Please enter a valid last name.
First name format is valid	Please enter a valid first name.
Search fields are completed	<Field Name> is required for search.
Valid flight status format	Unable to retrieve flight status. Please check details.
Map access permissions granted	Please allow map access to view directions.
E-voucher category is selected	Please select an E-voucher category.
Location input is valid	Enter a valid location name.
QR code display for selected voucher is available	Unable to generate QR code. Please try again.
Confirm voucher selection	Please select a voucher to continue.
Defined route or custom destination is selected on map	Please choose a route or destination.
User's current location format is valid	Please enter a valid location or enable location access.
All map search fields are completed	Complete all required fields to search map.
Inline error messages display for failed validations	<Error message>

The validations listed in Table 5.25 are crucial for ensuring the website's functionality, user experience, and data integrity. These rules are designed to guide users, reduce input

errors, and make error handling more intuitive by displaying inline error messages when validation fails. For this project, we prioritized the initial three validations due to time constraints.

5.3 Database design

5.3.1 Overview and purposes

This section details the database design for effectively managing critical data within the flight reservation system. The structure is engineered to facilitate efficient data storage, retrieval, and management processes, which are vital for the system's operational functionality. The primary objectives include organizing passenger, flight, and reservation information to enable seamless scheduling, booking, and tracking of flights. Additionally, the design provides a framework for monitoring employee activities, managing partnerships, and processing voucher issuance and redemptions, thereby allowing for comprehensive data integration and scalability. The database design employs a relational framework that organizes key entities such as passengers, flights, reservations, and routes, interlinking them through clearly defined relationships. This organization ensures that relevant information can be consistently accessed and updated across various operations, ultimately supporting informed decision-making and maintaining data integrity within the system.

5.3.2 Deliverables

The deliverables for this database design include the following key components:

- **Entity-Relationship (ER) Diagrams:** Visual representations of the database entities, their attributes, and inter-entity relationships, providing a blueprint of the data structure.
- **Entity Definitions and Attributes:** Detailed documentation of each entity's purpose and core attributes, including data types, constraints, and primary/foreign key designations.
- **Data Normalization:** Process documentation to ensure minimized data redundancy and optimized storage efficiency.
- **Logical and Physical Data Models:** Logical diagrams are used to understand a specific SQL server's database schema and physical implementations.
- **Metadata Tables:** Metadata details for each core entity, facilitating data management and system maintenance.

5.3.3 Identify entities, relationship, attributes, data types, and constraints

The database is structured around core entities identified in Table 5.26, each representing a critical element within the reservation system. For instance, the People entity functions as a central hub containing personal information that branches into specific roles, such as Passengers and Employees. The Passengers entity maintains customer information, enabling tracking and reservation linking, while the Employees entity manages staff data essential for operational tasks. Table 5.27 details relationships among entities, such as one-to-many relationships between Aircrafts and Routes, which represent different flight paths for each aircraft, and Flights and Reservations, allowing for multiple reservations per flight. These relationships support database normalization, reducing data redundancy. The attributes for each entity, as shown in Tables 5.28 to 5.38, specify data types and constraints (e.g., primary keys, foreign keys, and unique constraints), ensuring data consistency and enforcing relational integrity. For example, the People entity includes attributes like PeopleID as a primary key and AccountID as a unique identifier, while entities like Aircrafts and Routes are connected through foreign keys, maintaining referential integrity.

Table 5.26: Entities used in the process

No.	Entity	Description
1	People	Stores basic information for individuals in the system serving as a central entity for shared personal details.
2	Passengers	Represents customers who book and take flights, allowing tracking of passenger data and linking them to flight reservations.
3	Employees	Manages information about staff members, including pilots, flight attendants, and all the departments for operational purposes.

4	Aircrafts	Contains data on the aircraft fleet including types and availability to support flight scheduling and maintenance tracking.
5	Airports	Holds information on airport locations and is used to define routes and flight schedules.
6	Routes	Defines flight paths between airport locations and is used for planning and organizing available flight routes.
7	Flights	Represents individual flight instances along specific routes, including flight details and operational status.
8	Reservations	Tracks bookings made by passengers, linking them to flights and enabling seat allocation and booking management.
9	Partners	Manages data on partner organizations, such as other airlines or service providers to facilitate collaborations and offers.
10	Vouchers	Represents vouchers issued to passengers, often in response to delayed or canceled flights for future use or compensation.
11	VoucherRedemption	Tracks the use of issued vouchers by passengers, helping manage and verify voucher redemption processes.

Table 5.27: Relationships among entities

Relationship	Type
People - Passengers	1-1
People – Employees	1-1
Aircrafts - Routes	1-n
Airports - Routes	1-n

Routes - Flights	1-n
Flights - Reservations	1-n
Passengers - Reservations	1-n
Partners - Vouchers	1-n
Vouchers - VoucherRedemption	1-n
Passengers - VoucherRedemption	1-n

Table 5.28: Attribution of the People entity

Attribute's Name	Data Types	Categories
PeopleID	INT	PK, Not Null
FirstName	VARCHAR	Not Null
LastName	VARCHAR	Not Null
BirthDate	DATE	Nullable
Gender	CHAR(1)	Nullable
AccountID	VARCHAR	Not Null, unique
Password	VARCHAR	Not Null
IsPassenger	INT	Not Null, Default 0
IsEmployee	INT	Not Null, Default 0

Table 5.29: Attribution of the Employees entity

Attribute's Name	Data Types	Categories
EmployeeID	INT	PK, Not Null
PeopleID	INT	FK, Not Null, references People.PeopleID

Position	VARCHAR	Not Null
Department	VARCHAR	Nullable
HireDate	DATE	Not Null

Table 5.30: Attribution of the Passengers entity

Attribute's Name	Data Types	Categories
PassengerID	INT	PK, Not Null
PeopleID	INT	FK, Not Null, references People.PeopleID
PassportNumber	VARCHAR	Nullable, unique

Table 5.31: Attribution of the Aircrafts entity

Attribute's Name	Data Types	Categories
AircraftID	INT	PK, Not Null
Model	VARCHAR	Not Null
Type	VARCHAR	Not Null
Capacity	INT	Not Null
Manufacturer	VARCHAR	Not Null

Table 5.32: Attribution of the Airports entity

Attribute's Name	Data Types	Categories
AirportID	INT	PK, Not Null
Name	VARCHAR	Not Null
City	VARCHAR	Not Null
Country	VARCHAR	Not Null
IATA_Code	CHAR(3)	Unique, Not Null

Table 5.33: Attribution of the Routes entity

Attribute's Name	Data Types	Categories
RouteID	INT	PK, Not Null
AircraftID	INT	FK, Not Null, references Aircrafts.AircraftID
OriginAirportID	INT	FK, Not Null, references Airports.AirportID
DestinationAirportID	INT	FK, Not Null, references Airports.AirportID
Distance	INT	Not Null

Table 5.34: Attribution of the Flights entity

Attribute's Name	Data Types	Categories
FlightID	INT	PK, Not Null
RouteID	INT	FK, Not Null, references Routes.RouteID
DepartureTime	DATETIME	Not Null
ArrivalTime	DATETIME	Not Null
Status	VARCHAR	Not Null

Table 5.35: Attribution of the Reservations entity

Attribute's Name	Data Types	Categories
ReservationID	INT	PK, Not Null
FlightID	INT	FK, Not Null, references Flights.FlightID
PassengerID	INT	FK, Not Null, references Passengers.PassengerID
SeatNumber	VARCHAR	Nullable
BookingDate	DATE	Not Null

Table 5.36: Attribution of the Partners entity

Attribute's Name	Data Types	Categories
PartnerID	INT	PK, Not Null
Name	VARCHAR	Not Null
Type	VARCHAR	Nullable
Phone	INT	Nullable
Email	VARCHAR	Not Null

Table 5.37: Attribution of the Vouchers entity

Attribute's Name	Data Types	Categories
VoucherID	INT	PK, Not Null
PartnerID	INT	FK, Not Null, references Partners.PartnerID
IssueDate	DATE	Not Null
ExpiryDate	DATE	Nullable
Amount	DECIMAL	Not Null

Table 5.38: Attribution of the VoucherRedemption entity

Attribute's Name	Data Types	Categories
RedemptionID	INT	PK, Not Null
VoucherID	INT	FK, Not Null, references Vouchers.VoucherID
PassengerID	INT	FK, Not Null, references Passengers.PassengerID
RedemptionDate	DATE	Not Null
RedemptionAmount	DECIMAL	Nullable, derived

5.3.4 Entity Relationship Diagram

The Enterprise Data Model presented in Figure 5.71 serves as a comprehensive framework for the flight reservation system's data architecture, offering a high-level view of how core entities are interconnected across the entire database. This model captures the essential entities, attributes, and relationships required to manage complex data interactions within the system, encompassing passenger information, flight details, employee records, partnerships, and reservation processes. Each entity in the model, such as People, Passengers, Employees, Flights, and Reservations, is strategically designed with primary and foreign keys to maintain referential integrity and data consistency. Relationships, including one-to-one and one-to-many associations, reflect real-world operations; for example, the one-to-many connection between Passengers and Reservations allows each passenger to have multiple bookings, while the one-to-many relationship between Routes and Flights facilitates the organization of recurring flights along specified routes.

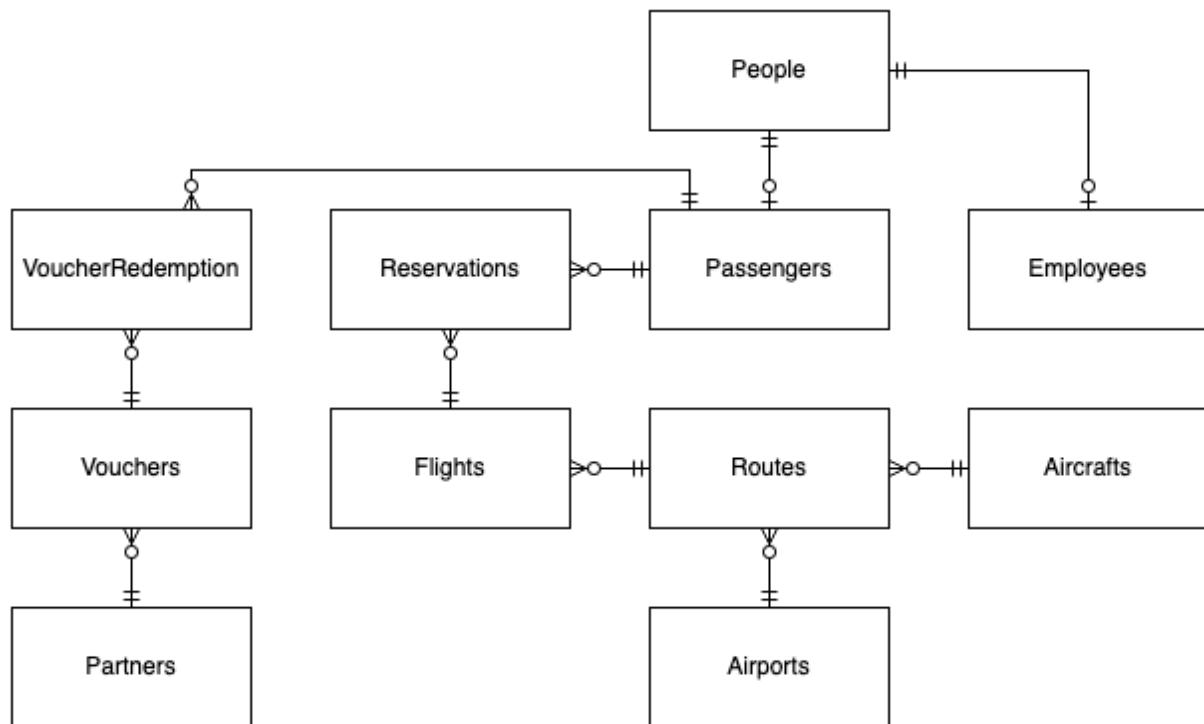


Figure 5.71: Enterprise Data Model

The Project Data Model, illustrated in Figure 5.72, presents a detailed, functional view of the flight reservation system's data structure, focusing on the specific entities, attributes,

and relationships essential for executing day-to-day operations. This model emphasizes the primary and foreign key associations that enable seamless interaction among critical entities, including People, Passengers, Flights, Reservations, Routes, and Vouchers. Each entity is designed to capture necessary data for its function within the system, facilitating effective tracking, retrieval, and management of information. In the Project Data Model, relationships such as one-to-many and one-to-one are mapped to accurately represent how entities interact. For example, the one-to-many relationship between Passengers and Reservations supports multiple bookings per passenger, while the one-to-many link between Flights and Reservations facilitates a single flight carrying multiple passengers. Additionally, the model accounts for collaborations with external partners via the Partners and Vouchers entities, providing a structured approach for managing partnerships, voucher issuance, and redemption tracking.

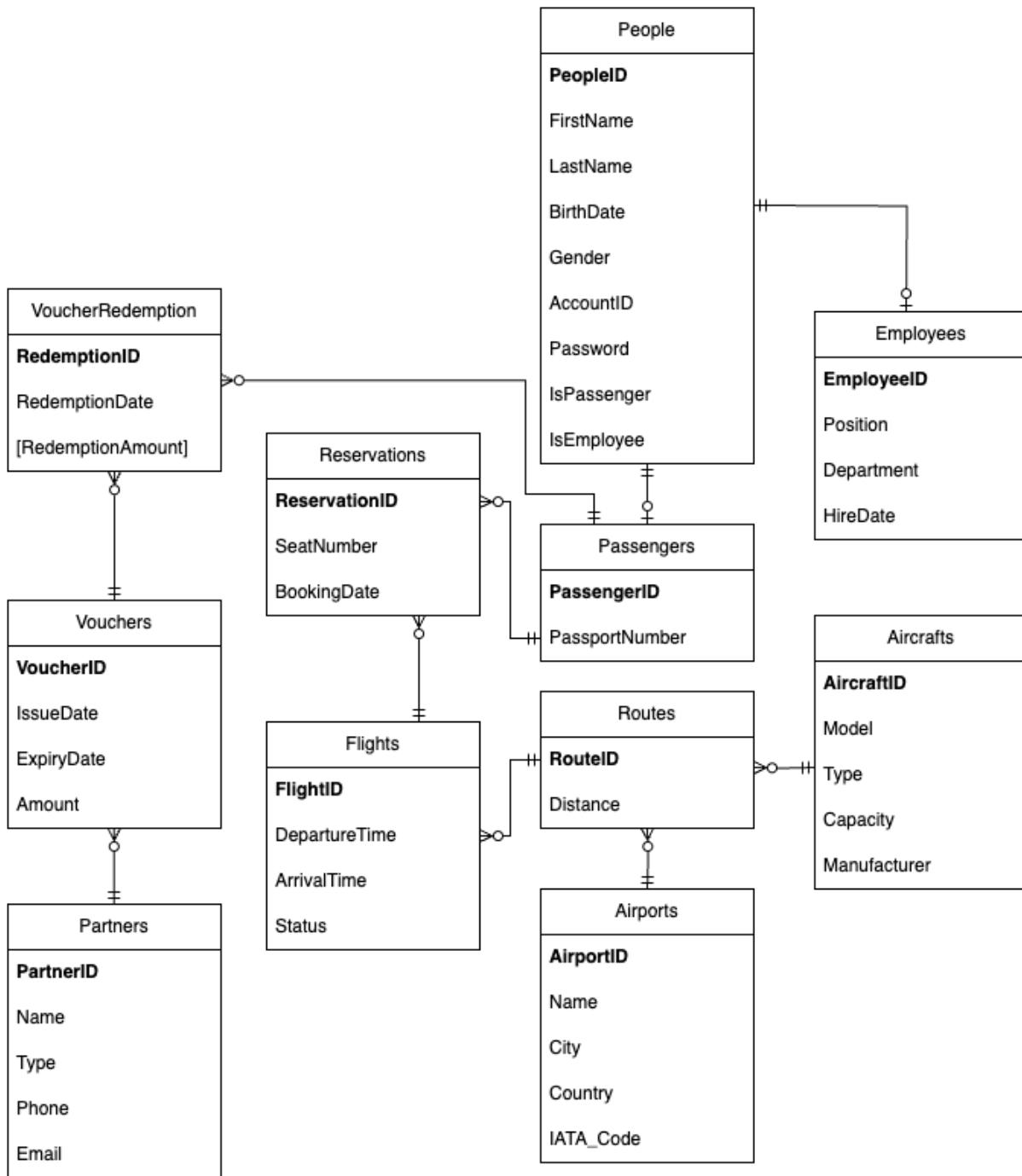


Figure 5.72: Project Data Model

5.3.5 Data Normalization

The database design undergoes data normalization, as shown in Figure 5.73, to reduce redundancy and ensure efficient data storage. This logical data model supports smooth data retrieval and updates, enhancing overall system performance.

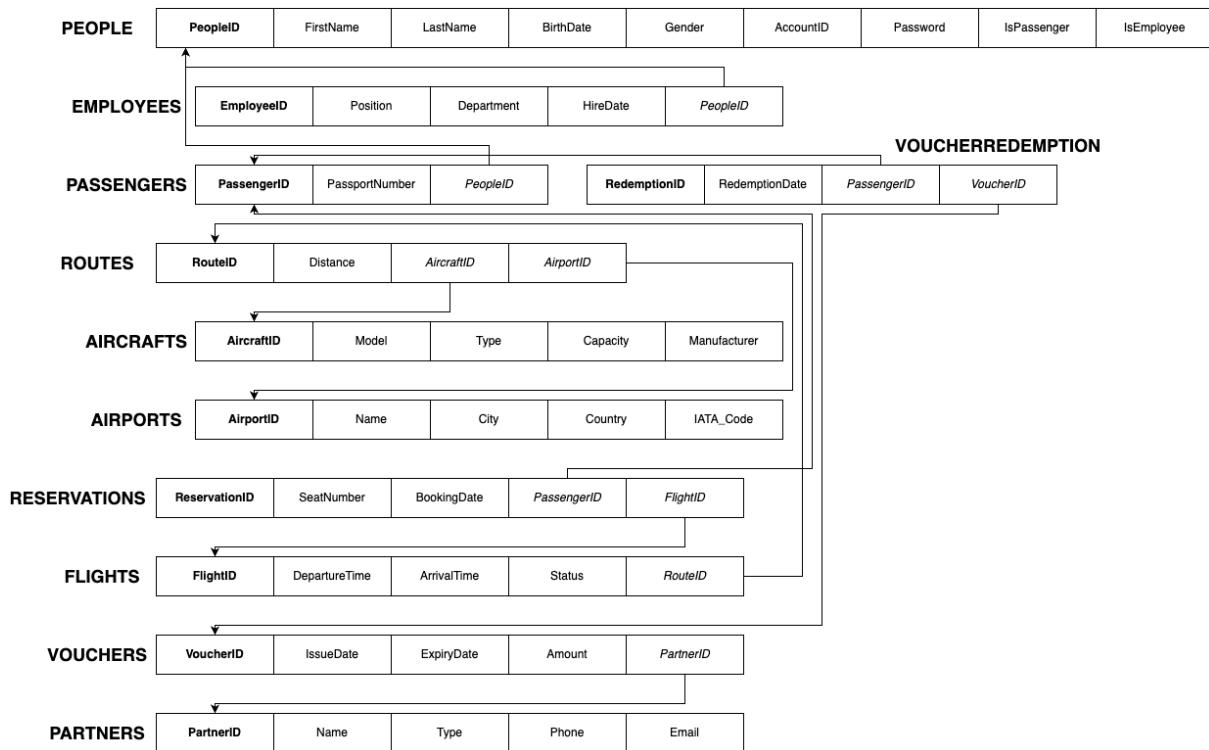


Figure 5.73: Logical data model

5.3.6 Physical database in SQL server

The physical database model, represented in Figure 5.74, maps the logical structure into a SQL server, creating tables, indices, and constraints as per the design. The metadata for core entities, such as Aircrafts, Airports, Employees, and Passengers, is detailed in Figures 5.75–5.85, ensuring structured data management and retrieval. This database design provides a robust framework for the flight reservation system, ensuring efficient handling of reservations, schedules, and customer data, as well as supporting scalability and data integrity for future developments.

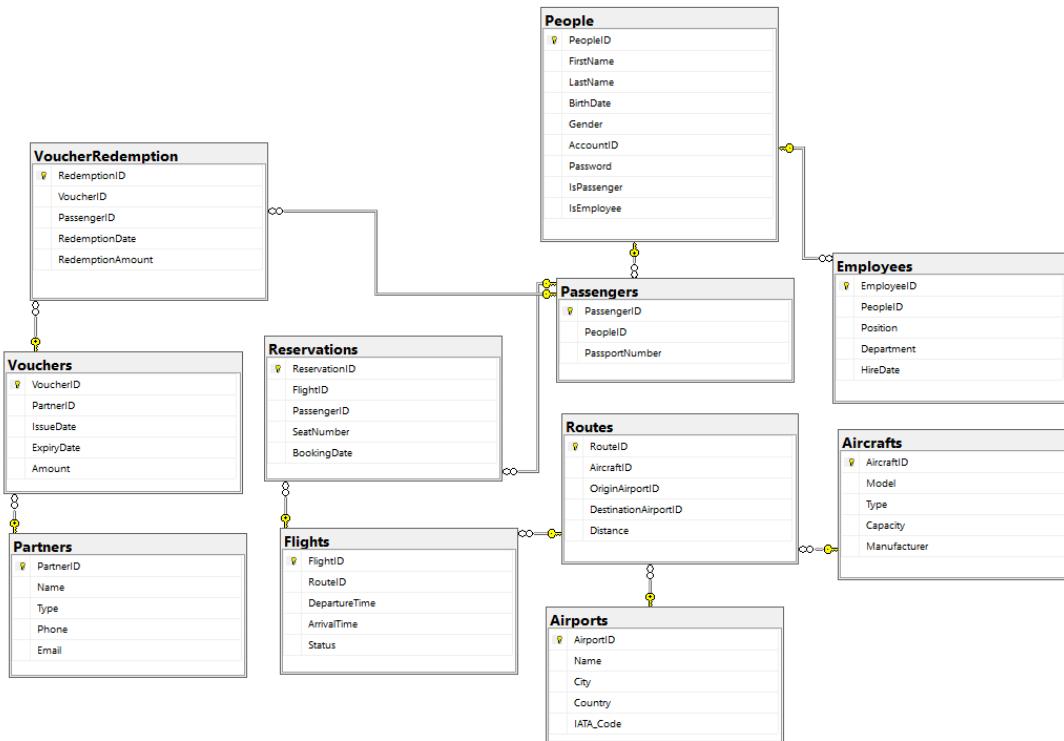


Figure 5.74: Physical data model

Column Name	Data Type	Allow Nulls
AircraftID	int	<input type="checkbox"/>
Model	varchar(255)	<input type="checkbox"/>
Type	varchar(255)	<input type="checkbox"/>
Capacity	int	<input type="checkbox"/>
Manufacturer	varchar(255)	<input type="checkbox"/>

Figure 5.75: Metadata of Aircrafts

Column Name	Data Type	Allow Nulls
AirportID	int	<input type="checkbox"/>
Name	varchar(255)	<input type="checkbox"/>
City	varchar(255)	<input type="checkbox"/>
Country	varchar(255)	<input type="checkbox"/>
IATA_Code	char(3)	<input type="checkbox"/>
		<input type="checkbox"/>

Figure 5.76: Metadata of Airports

Column Name	Data Type	Allow Nulls
EmployeeID	int	<input type="checkbox"/>
PeopleID	int	<input type="checkbox"/>
Position	varchar(255)	<input type="checkbox"/>
Department	varchar(255)	<input checked="" type="checkbox"/>
HireDate	date	<input type="checkbox"/>
		<input type="checkbox"/>

Figure 5.77: Metadata of Employees

Column Name	Data Type	Allow Nulls
FlightID	int	<input type="checkbox"/>
RouteID	int	<input type="checkbox"/>
DepartureTime	datetime	<input type="checkbox"/>
ArrivalTime	datetime	<input type="checkbox"/>
Status	varchar(50)	<input type="checkbox"/>
		<input type="checkbox"/>

Figure 5.78: Metadata of Flights

Column Name	Data Type	Allow Nulls
PartnerID	int	<input type="checkbox"/>
Name	varchar(255)	<input type="checkbox"/>
Type	varchar(255)	<input checked="" type="checkbox"/>
Phone	varchar(15)	<input checked="" type="checkbox"/>
Email	varchar(255)	<input type="checkbox"/>
		<input type="checkbox"/>

Figure 5.79: Metadata of Partners

Column Name	Data Type	Allow Nulls
PassengerID	int	<input type="checkbox"/>
PeopleID	int	<input type="checkbox"/>
PassportNumber	varchar(255)	<input checked="" type="checkbox"/>
		<input type="checkbox"/>

Figure 5.80: Metadata of Passengers

Column Name	Data Type	Allow Nulls
PeopleID	int	<input type="checkbox"/>
FirstName	varchar(255)	<input type="checkbox"/>
LastName	varchar(255)	<input type="checkbox"/>
BirthDate	date	<input checked="" type="checkbox"/>
Gender	char(1)	<input checked="" type="checkbox"/>
AccountID	varchar(255)	<input type="checkbox"/>
Password	varchar(255)	<input type="checkbox"/>
IsPassenger	int	<input type="checkbox"/>
IsEmployee	int	<input type="checkbox"/>
		<input type="checkbox"/>

Figure 5.81: Metadata of Peoples

Column Name	Data Type	Allow Nulls
ReservationID	int	<input type="checkbox"/>
FlightID	int	<input type="checkbox"/>
PassengerID	int	<input type="checkbox"/>
SeatNumber	varchar(10)	<input checked="" type="checkbox"/>
BookingDate	date	<input type="checkbox"/>
		<input type="checkbox"/>

Figure 5.82: Metadata of Reservations

Column Name	Data Type	Allow Nulls
RoutID	int	<input type="checkbox"/>
AircraftID	int	<input type="checkbox"/>
OriginAirportID	int	<input type="checkbox"/>
DestinationAirportID	int	<input type="checkbox"/>
Distance	int	<input type="checkbox"/>
		<input type="checkbox"/>

Figure 5.83: Metadata of Routes

Column Name	Data Type	Allow Nulls
RedemptionID	int	<input type="checkbox"/>
VoucherID	int	<input type="checkbox"/>
PassengerID	int	<input type="checkbox"/>
RedemptionDate	date	<input type="checkbox"/>
RedemptionAmount	decimal(10, 2)	<input checked="" type="checkbox"/>
		<input type="checkbox"/>

Figure 5.84: Metadata of Voucher redemptions

Column Name	Data Type	Allow Nulls
VoucherID	int	<input type="checkbox"/>
PartnerID	int	<input type="checkbox"/>
IssueDate	date	<input type="checkbox"/>
ExpiryDate	date	<input checked="" type="checkbox"/>
Amount	decimal(10, 2)	<input type="checkbox"/>
		<input type="checkbox"/>

Figure 5.85: Metadata of Vouchers

Part 6. Project Plan

6.1 Work Breakdown Structure

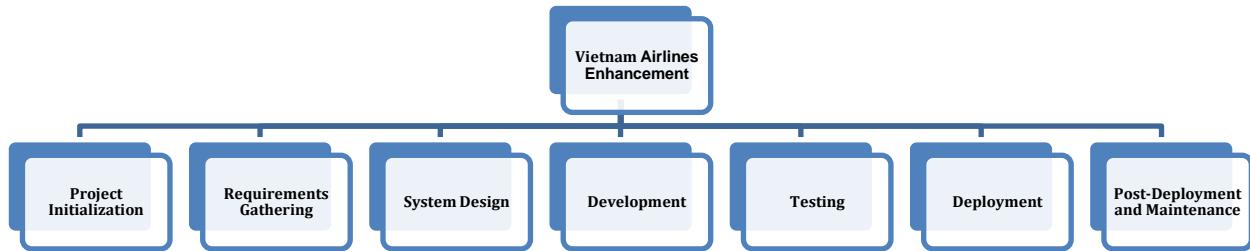


Figure 6.1: Work breakdown structure

Project Initialization

- Define objectives, requirements
- Conduct stakeholder analysis
- Draft project charter, business case
- Set up project resources, budget, and schedule

Requirements Gathering

- Conduct interviews, surveys
- Gather functional, non-functional requirements
- Present findings,
- Get stakeholder sign-off

System Design

- Create system architecture
- Create technical design documents
- Develop DFD
- Develop BPMN
- Define database structure, data dictionary
- Design user interface

Development

- Implement GPS navigation
- Implement voucher issuance systems

- Integrate real-time airport map
- Integrate flight delay compensation features
- Set up back-end SQL
- Conduct integration of all modules
- Ensure compatibility with iOS, Android

Testing

- Perform integration, system testing
- Compile testing reports
- Address any issues identified

Deployment

- Prepare deployment plan
- Ensure app compliance
- Implement customer notification for new app features

Post-Deployment and Maintenance

- Monitor app performance
- Gather user feedback
- Conduct continuous maintenance
- Plan for future feature expansions

6.2 Project Milestones

Table 6.1: Project Milestones

	Milestone 1	Milestone 2	Milestone 3	Milestone 4	Milestone 5
Deliverables	Project Charter	Requirements Specification	Data and process modelling	Object modelling	User interface and data design
Steps	Project Objective Assumptions Project Scope Responsibilities Resources Project Risks Signatures	Requirements gathering Interviews, Surveys Document analysis for user needs.	Complete system architecture DFDs BPMN	Use case diagram Class diagram Sequence diagram Activity diagram	Database structure UI prototypes.
Date	From 18/10/2024 to 21/10/2024	From 22/10/2024 to 27/10/2024	From 27/10/2024 to 31/10/2024	From 01/11/2024 to 06/11/2024	From 06/11/2024 to 08/11/2024

Part 7. Lessons Learnt

Table 7.1: What did not work well

No.	Issue/what did not work well	What the team should have done instead?	Lesson Learned
1	Don't model UML diagrams in the consistent tool	Find another tool that helps more functions to finish all diagrams	Plan, find and evaluate all tools before starting the project
2	There are additional entities in ERD compared to the data flow diagram and class diagram	Compare and add missed entities in DFD and class diagram	Do the ERD, DFD, and Class Diagram simultaneously
3	There are some crosslines in the diagrams	Move symbols in diagrams to prevent it	Find ways to avoid crosslines when doing UML diagrams
4	In the requirements gathering process, the methods were still somewhat vague	Only mention the requirements-gathering methods that were clearly used during the system development process	Spend more time revising the theory of fact-finding techniques to identify what should included in the project

Table 7.2: What worked well

No.	What worked Well	Lesson Learned
1	Fulfilled all the project requirements	The UML diagrams are fully presented and detailed
2	The prototype of the Vietnam Airlines website on mobile includes all the functionalities of the current system and adds new features	The colors, design style, and spacing of the new functionalities match those of the current website
3	Identifying issues in the airline's system with high practical applicability	Two issues have been identified: unclear procedures for handling flight delays and difficulties in navigating the new airport
4	Meeting the plagiarism requirements	The plagiarism rate is below 30%

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