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# **Software Requirements Specification**

for

# **Flight Management System**

**Version 1.0 approved**

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## **Revision History**

<b>Name</b>	<b>Date</b>	<b>Reason For Changes</b>	<b>Version</b>

# 1. Introduction

## 1.1 Purpose

The main purpose of this document is to illustrate the software requirements for the Flight Management System (FMS). The document gives the scope as well as detailed description of both functional and non-functional requirements of the system. This project is aimed at providing a user-friendly interface for pilots, flight crew, aviation administrators (air traffic control), maintenance team, airport authorities, regulatory authorities, and passengers and travel agencies.

## 1.2 Document Conventions

- Convention for Main Heading:  
Font Face: Times  
Font Style: Bold  
Font Size: 18
- Convention for Subheading:  
Font Face: Times  
Font Style: Bold  
Font Size: 14
- Convention for Body:  
Font Face: Arial  
Font Style: None  
Font Size: 11

## 1.3 Intended Audience and Reading Suggestions

This document is designed for the Course Instructor for Software Requirement Engineering, Sir Muazzam Ali Shah, the developers of the System, stakeholders and administration and faculty of FAST NUCES, Karachi.

Stakeholders include:

1. Airlines:  
Airlines are the primary bodies of the aviation industry providing air transportation to the people all around the world. They manage different air crafts, plan their routes and provide safe travels.
2. Airport Authorities:  
Airport authorities play a vital role in managing all the activities taking place in the airports and within its range. They make sure to provide safe departures and landings to the air crafts of different airlines.
3. Air Traffic Controllers:

Air traffic controllers are responsible for instructing pilots about any obstruction during flights. Their vital role is to make sure there is efficiency in the flight's movement and to keep them safe from any kind of mishap i.e. collisions.

4. Maintenance team:

Maintenance team is responsible for maintaining the system and as well as notify that the aircrafts are going through regular inspections and they have been going through repairs, if any.

5. Pilots and Flight Crew:

Pilots and flight crew members have a strict schedule, consecutive flight and managing their free time. To following such schedule, system provides them with their timetable that shows their schedule and notify whenever they have to be on duty.

6. Passengers and Travel Agencies:

Passengers and travel agencies are the stakeholders that keep the flights running. They rely on the flight management system to reserve a seat, book flights (like single way, round way, multicity). FMS helps them to book flights easily by providing them a platform.

7. Ground Handling Services:

Ground handling services include the baggage handling, refueling of the aircraft and boarding of the passengers. They ensure that the flights depart and arrive on time.

8. Aviation Software Developers:

Aviation software developers help assist pilots navigating and route planning. They help contribute in all aspects of technological advancements.

9. Cargo Logistics Providers:

They specialize in the transportation of cargo in the air. The customers rely on air transportation of the goods as they are secure and delivered on time.

## 1.4 Product Scope

The product scope of the FMS is to design an enhanced management system for aviation operations. The System will provide support functionalities for airlines and aviation authorities to be able to effectively handle various aspects of flight management. The key features of the Flight Management System will include: Flight Planning And Scheduling, Aircraft Management, and Security.

## 1.5 References

- Websites:
- <https://standards.ieee.org/>
- [https://www.globalspec.com/learnmore/specialized\\_industrial\\_products/transportation\\_products/flight\\_management\\_systems](https://www.globalspec.com/learnmore/specialized_industrial_products/transportation_products/flight_management_systems)
- <https://www.sciencedirect.com/topics/computer-science/flight-management-system>
- [https://www.researchgate.net/figure/Hardware-architecture-of-Flight-Management-System\\_fig9\\_294887257](https://www.researchgate.net/figure/Hardware-architecture-of-Flight-Management-System_fig9_294887257)
- [https://www.researchgate.net/figure/Flight-Management-System-Hardware\\_fig1\\_266591950](https://www.researchgate.net/figure/Flight-Management-System-Hardware_fig1_266591950)

- [https://en.m.wikipedia.org/wiki/Flight\\_management\\_system](https://en.m.wikipedia.org/wiki/Flight_management_system)

## 2. Overall Description

### 2.1 Product Perspective

The Flight Management System (FMS) builds a relationship with the users that ensures effective flight operation. It ensures data security and presents a user friendly environment to every stakeholder. The flight management system promises security, safety and the aviation experience.

### 2.2 Product Functions

- User Interface:
  - Passenger interface
  - Administration interface
- Hardware interfaces should come with a huge amount of storage and memory for the system to run on.
- Software interfaces should have certifications and integration with other systems.
- Communication interfaces should communicate effectively with the database and all of its features.

### 2.3 User Classes and Characteristics

- Pilots and Flight Crew:  
Pilots and flight crew are highly trained people who have in-depth knowledge about the system. They need a friendly interface so that they can have quick access to options like navigating, route planning and other options.
- Maintenance Engineers:  
The engineers are here to update and maintain the system as soon as the new update comes in. They look over software updates and configuration systems.
- Administration Staff:  
The administration staff is one of the stakeholders who has in-depth knowledge about the system. They plan not only the flight plans but also the flight crew's plan.
- Regulatory authorities:  
The authorities look after all the safety measures. They inspect and have access to the logs, charts, data and all the system information.
- Trainers:  
They are here to teach stakeholders how to use the Flight Management System to prevent any kind of errors.

## 2.4 Operating Environment

- The server-side components of the software system must operate within the windows operating system, a better experience with windows 7, 8 and 10.
- The user-side components of the software system must operate within the latest stable release of android and IOS as well as common web-browser environments.
- The minimum set of androids and IOS that must support this app are:
  - Android 9 and above.
  - IOS 10 and above.
- The minimum set of browsers that must be compatible with system are:
  - Internet Explorer
  - Safari
  - Firefox
  - Google Chrome
- Whole system on the user side should be connected to the WIFI.
- Language used: JAVA

## 2.5 Design and Implementation Constraints

- The system should be compatible and run-on the following operating systems:
  - Android version 9.0 (Pie) or above.
  - IOS version 10 or above.
  - Windows 7 and above.
  - macOS version OS X Mavericks and above.
- The FMS system should be compatible with smartphones as well as tablets.
- The software should be developed using Microsoft.net framework.
- The system should be using FireBase as BDMS.

## 2.6 User Documentation

- Staff will be provided with a user manual for the new system.
- Users on the other hand will be provided with a how-to tutorial on the website.

## 2.7 Assumptions and Dependencies

- It is assumed that:
  - Employees will be trained to operate the system.
  - System will work efficiently with Windows OS and FBDB.
- System have several dependencies:
  - GUI is in English only.
  - Only the admin can add employees.
  - System access will only be granted if the user enters a valid username and password.

- In case of any potential change in assumed facts or system dependencies, SRS should be flexible enough to adjust accordingly.

### 3. External Interface Requirements

#### 3.1 User Interfaces

The user interface for the FMS must be user-friendly and should offer an effective and intuitive interface for the aviation staff and passengers. It should facilitate easy access to features like: Flight Planning and Scheduling; Aircraft, Crew and Passenger Management; Reports and Analysis etc.

The user interface must follow the GUI standards and style guides of the FMS product family. The user interface must also provide standard buttons and functions (e.g., help, back, exit) that will appear on every screen, keyboard shortcuts, error message display standards, and so on. The user interface design details should be documented in a separate user interface specification.

##### 3.1.1 Passenger Interface:

The passenger interface is the interface between the FMS and the passengers who want to book or schedule flights. The passenger interface must include the following screens:

- Login/Sign-up:  
The user will be greeted by a welcome screen. The user will be able to login with their credentials or sign up for a new account. The user will be given the flight booking menu after logging in or signing up.
- Flight Booking/Scheduling:  
The user will be able to book or schedule flights by selecting the type of flight (one-way, round-way, etc.), the travel class (business, economy, etc.), the departure location and the destination. The user will be able to view the available flights, the fares, the duration, and the departure and arrival times. The user will be able to confirm or cancel their booking or scheduling.
- User Support:  
The user will be able to access the instructions guide for booking or scheduling flights, and navigating through other system features. The user will also be able to contact the customer service team for any issues or queries.

##### 3.1.2 Administration Interface:

The administration interface is the interface between the FMS and the administration staff who manage the flight operations. The administration interface must include the following screens:

- Login/Sign-up:  
The user will be greeted by a welcome screen. The user will be able to login with their credentials or sign up for a new account. The user will be given access to the administration dashboard after logging in or signing up.
- Flight Booking/Scheduling:  
The user will be able to view, edit, and cancel the flight bookings and schedules of the passengers. The user will also be able to create new flights and assign aircrafts and crews to them.



- Crew Management:  
The user will be able to view, edit, and delete the information of the flight crew members. The user will also be able to assign crew members to flights and monitor their availability and qualifications.
- Aircraft Management:  
The user will be able to view, edit, and delete the information of the aircrafts. The user will also be able to track the status and location of the aircrafts and schedule maintenance activities for them.
- Passenger Management  
The user will be able to view, edit, and delete the information of the passengers. The user will also be able to check-in passengers, issue boarding passes, and handle baggage and seat assignments.
- Maintenance Tracking:  
The user will be able to view, edit, and delete the information of the maintenance tasks. The user will also be able to receive notifications for upcoming maintenance tasks and mark them as completed or pending.
- Generate Reports/View Analytics:  
The user will be able to generate and view various reports and analytics related to the flight operations, such as revenue, expenses, customer satisfaction, flight performance, etc.
- User Support:  
The user will be able to access the instructions guide for using the administration interface and navigating through other system features. The user will also be able to contact the technical support team for any issues or queries.

## 3.2 Hardware Interfaces

The FMS requires robust hardware with ample memory, storage and processing power to be able to efficiently support features such as Flight Planning and Scheduling; Aircraft, Crew and Passenger Management; Reports and Analysis etc.

It should also:

- Comply with DO-178C (Standard for software used in airborne systems).
- Satisfy environmental conditions stated in DO-160 which includes temperature, humidity, altitude, vibration, and electromagnetic interference.
- Hardware must be adequately redundant to meet aviation safety standards (such as having multiple processors).

## 3.3 Software Interfaces

The FMS requires software that:

- Complies with DO-178C for software development assurance.
- It is Integrated with other systems (such as navigation databases while keeping adherence to ARINC424 standards).
- Complies with aviation regulations and standards set by authorities like the FAA or EASA.

### 3.4 Communications Interfaces

The FMS must communicate effectively with all its features and databases. It should be:

- Complaint with communication standards such as ARINC 429 or ARINC 661.
- Integrate with other avionics systems (data exchange).
- Be secure and reliable communication protocols (prevent unauthorized access or interference).

## 4. System Features

### 4.1 Flight Planning and Scheduling

#### 4.1.1 Description and Priority

This Feature enables the user to plan and schedule flights efficiently. It considers factors such as routes, available aircrafts, and availability of crew for the passenger and administration. Use can choose if they wanna go one-way or round-way, take cheapest or fastest flight, select departure time/location. This feature is of High Priority.

#### 4.1.2 Stimulus/Response Sequences

When the passenger/administration initiates flight planning, the System displays available routes, aircraft and crew options. When the passenger/administration selects a route, aircraft and crew, System validates selections and confirms the flight schedule.

#### 4.1.3 Functional Requirements

REQ-1: The system should provide a user interface for flight planning.

REQ-2: The system should display real-time information about available routes.

REQ-3: The system should suggest the best aircraft based on selected route and availability to the passenger.

REQ-4: The system should verify crew availability and choose them for the selected flight by the passenger.

REQ-5: The system should display appropriate error messages for invalid inputs.

### 4.2 Aircraft Management

#### 4.2.1 Description and Priority

This feature tracks and manages the fleet of aircraft, including maintenance schedules and availability. This feature has high priority.

#### 4.2.2 Stimulus/Response Sequences

When the administration accesses the Aircraft Management feature, the system displays the status and availability of the aircraft.

#### 4.2.3 Functional Requirements

REQ-6: The system should display real-time information about available routes.

REQ-7: The system should suggest the best aircraft based on selected route and availability to the passenger.

REQ-8: The system should verify crew availability and choose them for the selected flight by the passenger.

REQ-9: The system should display appropriate error messages for invalid inputs.

REQ-10: The system should display real-time information about status and location of aircrafts.

REQ-11: Administration shall be able to schedule and view maintenance activities for each aircraft.

### 4.3 Crew Management

#### 4.3.1 Description and Priority

This feature manages the scheduling, availability and qualifications of the flight crews. This feature has high priority.

#### 4.3.2 Stimulus/Response Sequences

When the Administration accesses the Crew Management feature, the system displays the current crew plannings and allows the user to edit it.

#### 4.3.3 Functional Requirements

REQ-12: The system should maintain a database of all qualified flight crew members.

REQ-13: The system should allow Administration to view and edit crew duty planning.

REQ-14: Crew availability should be updated based on assigned flights.

### 4.4 Maintenance Tracking

#### 4.4.1 Description and Priority

This feature monitors and schedules upcoming maintenance activities to ensure aircrafts are in optimal condition. This feature has high priority.

#### 4.4.2 Stimulus/Response Sequences

When the system detects an upcoming maintenance task, the system generates a maintenance alert for the personnel. When maintenance is completed and logged in the system, System updates the aircraft status and clears the maintenance alert.

#### 4.4.3 Functional Requirements

REQ-15: The system should maintain a log of all maintenance activities.

REQ-16: The Administrators should receive notifications for upcoming maintenance tasks.

REQ-17: Maintenance tasks should be categorized based on urgency and importance.

## **4.5 Passenger Management**

### **4.5.1 Description and Priority**

This feature provides tools for managing passenger information, bookings and check-ins. This feature is controlled by Administration. This feature has high priority.

### **4.5.2 Stimulus/Response Sequences**

When the Passenger searches for available flights, System displays a list of available flights and booking options. When the passenger completes the booking process, the system confirms the booking and updates passenger records.

### **4.5.3 Functional Requirements**

REQ-18: The system should provide a user-friendly interface for passengers to search and book flights.

REQ-19: The system should support online check-in functionality.

REQ-20: Passenger information should be securely stored in the system.

## **4.6 Reporting and Analytics**

### **4.6.1 Description and Priority**

This feature generates comprehensive reports and analytics on flight operations, crew performance, and aircraft status. This feature has high priority.

### **4.6.2 Stimulus/Response Sequences**

When the Administrators request a performance report for a specific timeframe, the system generates and displays the requested report.

### **4.6.3 Functional Requirements**

REQ-21: The system should provide real-time analytics on flight operations.

REQ-22: Reports should be available in various formats (e.g, PDF, Excel).

## **4.7 User Authentication and Authorization**

### **4.7.1 Description and Priority**

This feature ensures secure access to the system with role-based permissions for different types of users i.e passenger and Administration. This feature has high priority.

### **4.7.2 Stimulus/Response Sequences**

Users are first asked to authenticate whether they are Passenger or Administration. When the Passenger/Administration attempts to Log-in, giving correct credentials, the system verifies credentials and grants access based on the user's role.

#### 4.7.3 Functional Requirements

REQ-23: The system should implement secure user authentication mechanisms.

REQ-24: Role-specific access should be granted across different modules within the system.

REQ-25: Users should be prompted to re-authenticate when engaging in sensitive operations.

## 4.8 User Support

#### 4.8.1 Description and Priority

This feature provides training materials and supports resources for Passengers and administrators. This feature has medium priority.

#### 4.8.2 Stimulus/Response Sequences

When the Passenger/Administrators accesses the training materials section, the system displays user manuals and training modules.

#### 4.8.3 Functional Requirements

REQ-26: Passenger and Administrators would be given different user support based on the User-role.

REQ-27: The system should have a section for user manuals and training materials.

REQ-28: Training materials shall cover all system functionalities.

REQ-29: Users should be able to request support through the system interface.

## 5. Other Nonfunctional Requirements

### 5.1 Performance Requirements

- Security:  
Flight Management System is a crucial management system which can expect break-ins from unauthorized people or systems anytime. Thus, the system should detect and respond to such unauthorized access in under a minute. To prevent the sensitive information getting into the wrong hands, the system must be secure and must respond to such break-ins in time which will also prevent the potential risks to the integrity of the system.
- Real-time response:  
Flight Management System is used by various stakeholders, i.e. passengers, customers, maintenance staff, flight crew, etc. Thus, the system must have an exceptional response time. The system should respond to the user in under 2 seconds. This is called "swift response" and its purpose is to improve the user experience.
- Reliability:

Reliability prevents system failures. It is designed to detect the error and the mistakes, and correct them without crashing the whole system. A reliable Flight Management System ensures the operation of the system which helps reduce the potential issues throughout the system.

- Speed:  
The speed is one of the most important non-functional requirements as in the Flight Management System, efficiency of processing data is mandatory such as processing which flight is going to take off or which is going to come in, which user booked which flight, etc.
- Maintenance:  
Maintenance allows the regular check-up of the system and updating the system time-to-time to avoid the system being out-dated and to keep the system running without any crash.

## 5.2 Safety Requirements

- Fail safe-modes and recovery:  
Implementation of such fail-modes is mandatory for FMS as it can back up data as time passes continuously so that if an error occurs, the data stored in the system is safe and unharmed. The fail-recovery should overcome the issues occurred by the system and recover the data.
- Adherence to Regulatory Standards:  
Adherence to the regulatory standards define that the system promises safety requirements at every stage i.e. design, implementation, development and most importantly, at the use of the particular system.
- Adaptability to Changing Conditions:  
Designing the Flight Management System in a way that it adapts itself according to the environment. For example, calculating the flight time in every weather, confirmation and cancellation of the flight, etc.
- Safety Critical Certifications:  
The Flight Management System must undergo some safety critical testing. It includes the testing of the software and hardware considerations. The testing shows that the system meets all the safety and the reliability requirements.
- Documentation and training:  
Making a document helps understand what the management system comprises. Making of the manual guides, brochures and the training workshops helps the customers/users, flight crew, maintenance staff and all the other stakeholders know how to use it and what to do in case an error occurs.

## 5.3 Security Requirements

- Data Encryption:  
All the data, which includes details of the customer, passenger, flight crew, flights, etc, must be encrypted so that the information is safe from any unauthorized access.

- User Identity Authentication:  
It is mandatory for all the users using the Flight Management System to have various authentication methods to log in into the system to confirm their identity. Multi-factor authentication includes biometrics, passwords (with different combinations), smart cards, etc.
- Incident Response Plan:  
If a break in occurs, the system should detect it, plan an outline of the breakin and alert the security breaches.
- Security Certifications:  
Security certification helps the stakeholders know that the system has gone through security checks. It also makes sure that the system will not collect any personal information of the user.
- Third-party Security:  
Third-party security makes sure that the third-party is providing the same level of security to the system that it needs.

## 5.4 Software Quality Attributes

- Adaptability:  
The program has the tendency to be modified according to purpose over time.
- Availability:  
The features of the system are available whenever needed to be used.
- Maintainability:  
The coding of the software is done in a systematic manner, making it easy to understand. Any changes or modifications can be made easily without wasting a considerable amount of time in understanding the logic of the code.
- Portability:  
No differences in performance will be noted when run on different devices/systems.
- Reliability:  
All the calculations made are accurate, and functions are available when needed.
- Reusability:  
Separation of features into various functions makes it easier to reuse the code.
- Testability:  
Code is easy to test and identify errors from.
- Usability:  
The system is easy to use, and displays relevant messages whenever an error is made.

## **5.5 Business Rules**

- Data Privacy and Security:  
Informations of passengers, flight crew and all the workers have their information secure and can only be accessible to the authorized people.
- Flight Planning Restrictions:  
People like flight planners and administrators are authorized to plan flight schedules and make changes to it if necessary.
- Training and Permissions:  
Users using the Flight Management System should go through appropriate training so that they can prevent any kind of errors.
- Compliance and Regulations:  
The system must have regulatory standards and certifications. They should look for the any deviations and any kind of violations.



## **6. Other Requirements**

### **Appendix A: Glossary**

FMS: Flight Management System

REQ: Requirement

GUI: Graphical user interface

JDK: Java Development Kit

JRE: Java Run-time Environment

PDF: Portable Document Format

IOS: iPhone Operating System

DBMS: Database Management System

ARINC: Aeronautical Radio Incorporated

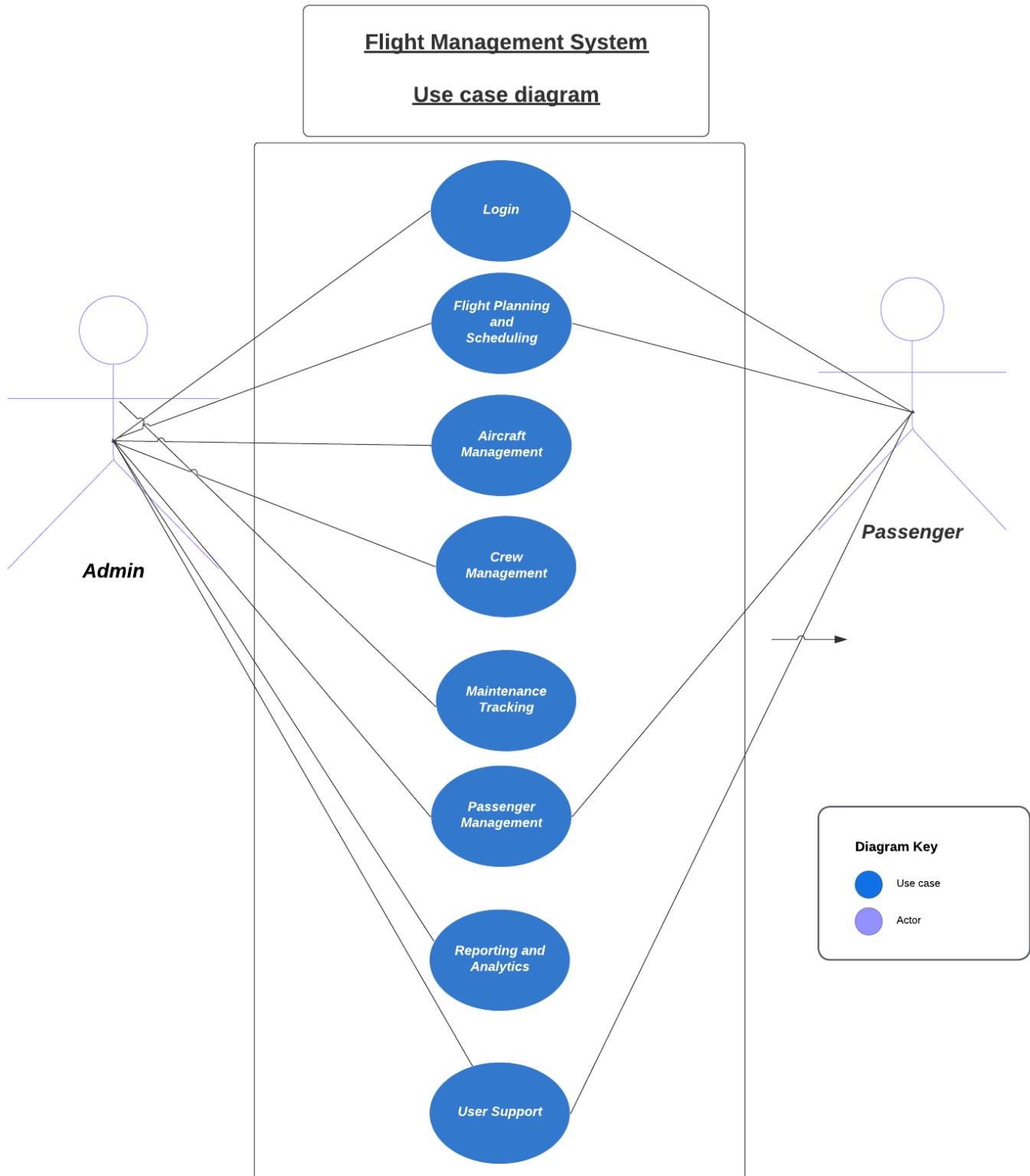
FAA: Federal Aviation Administration

EASA; European Aviation Safety Agency

DO: Document

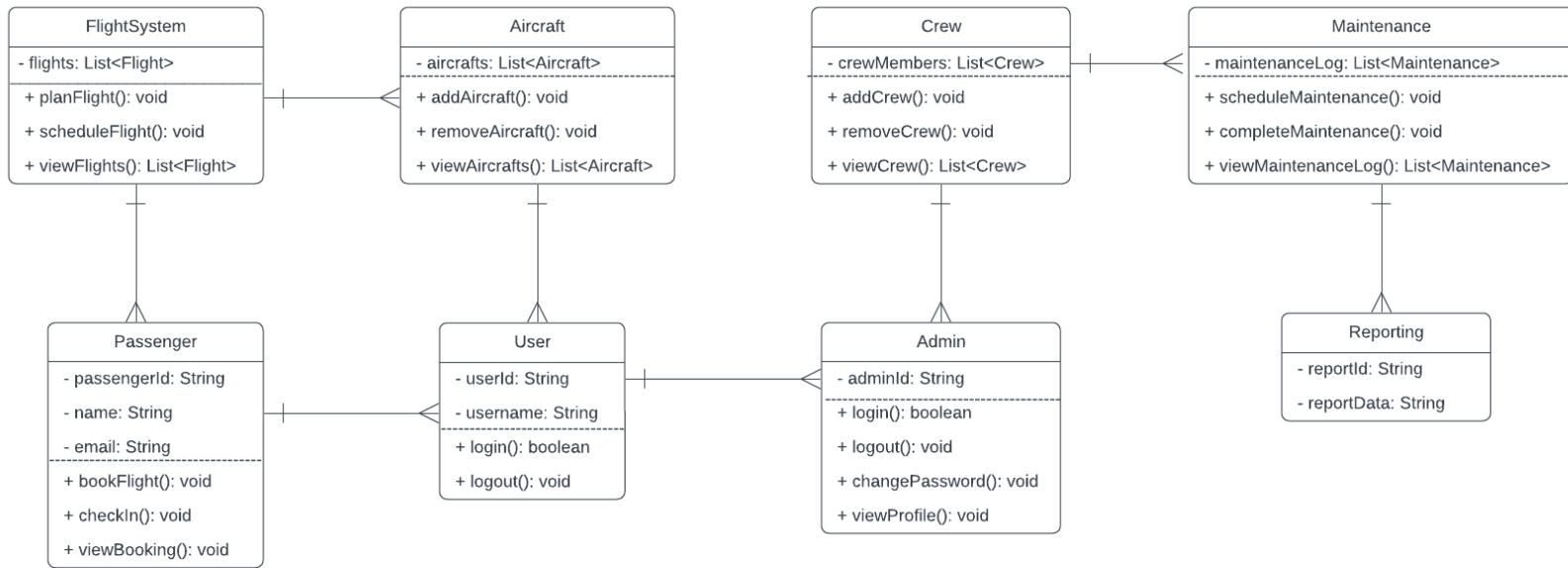
## Appendix B: Analysis Models

### 1) Use Case diagram

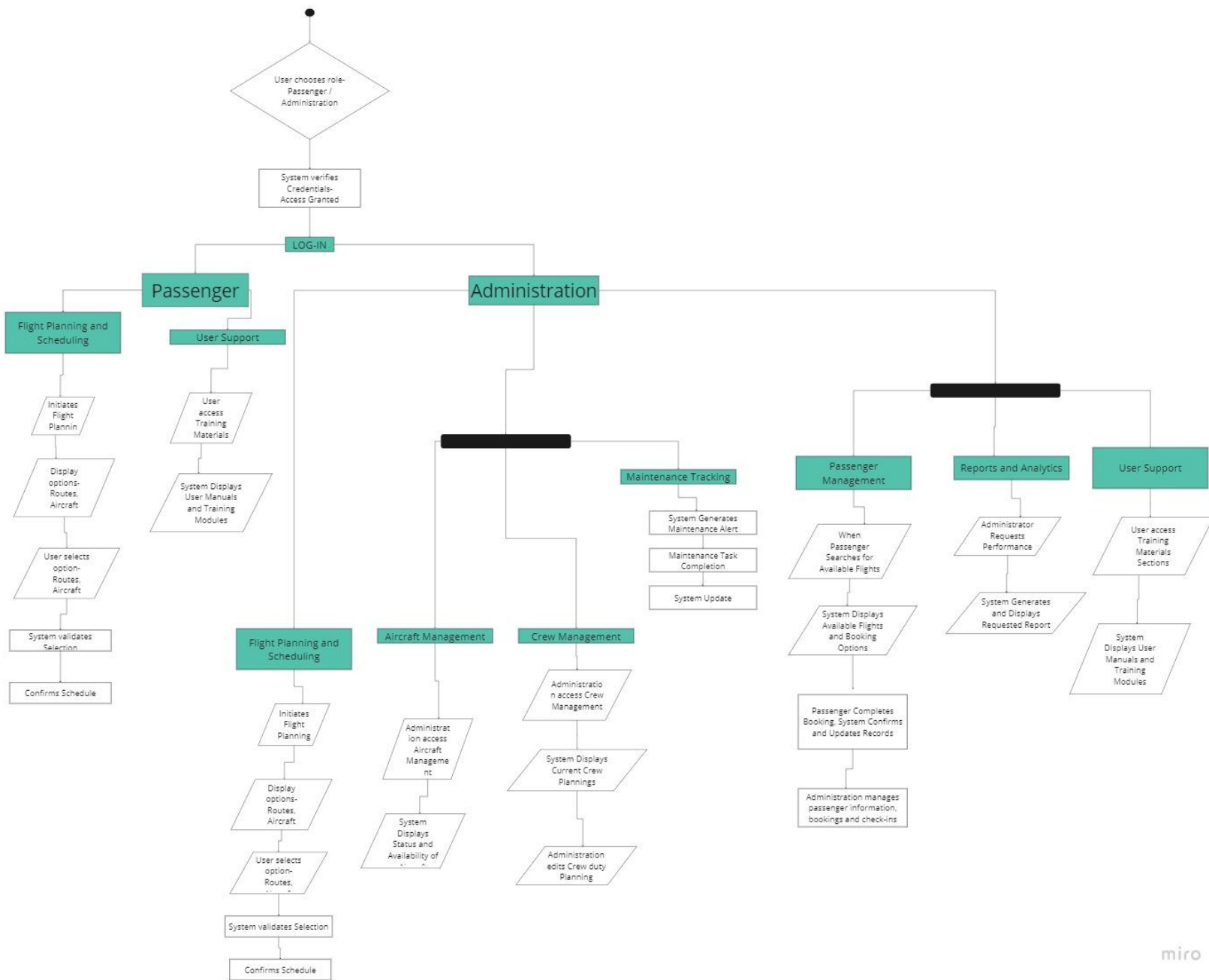


## 2) Class Diagram

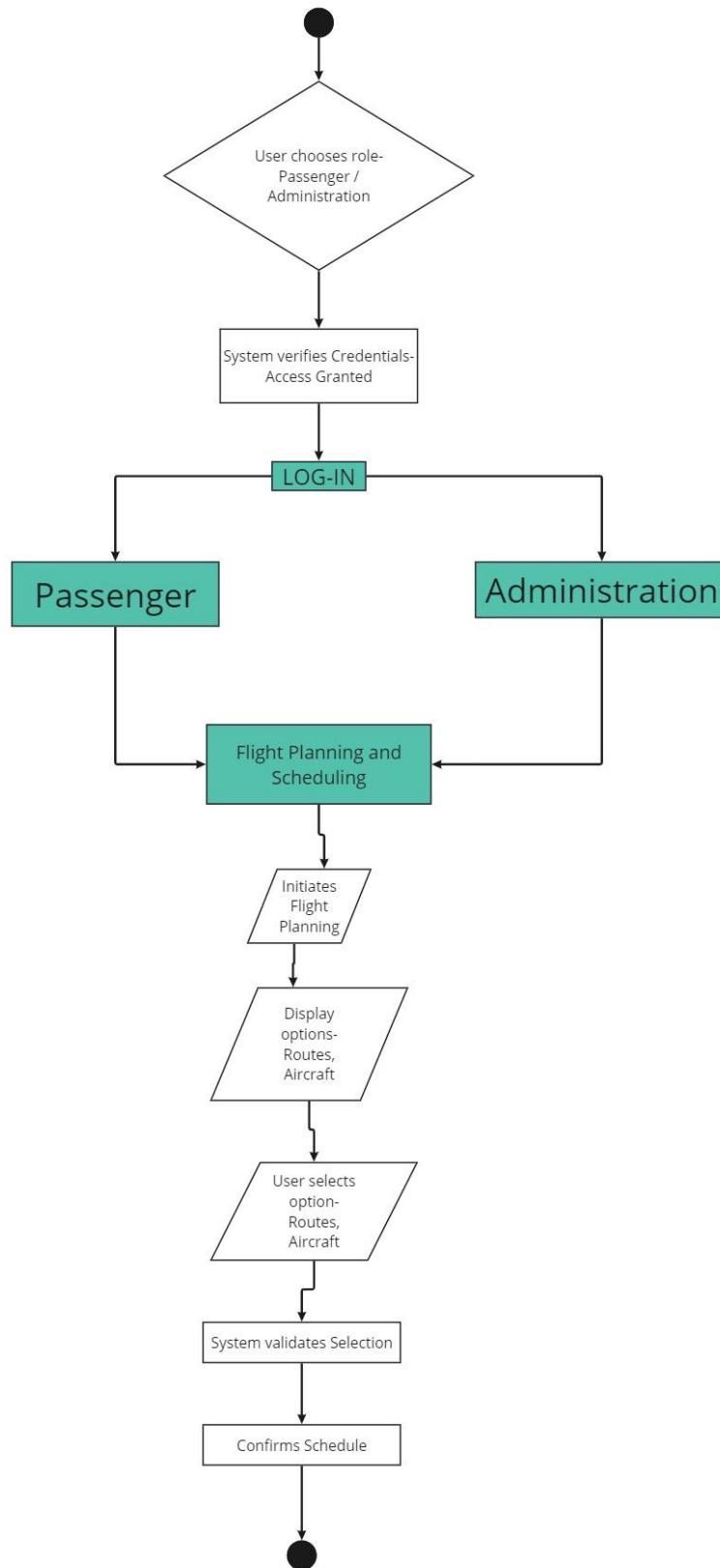
## Flight Management System



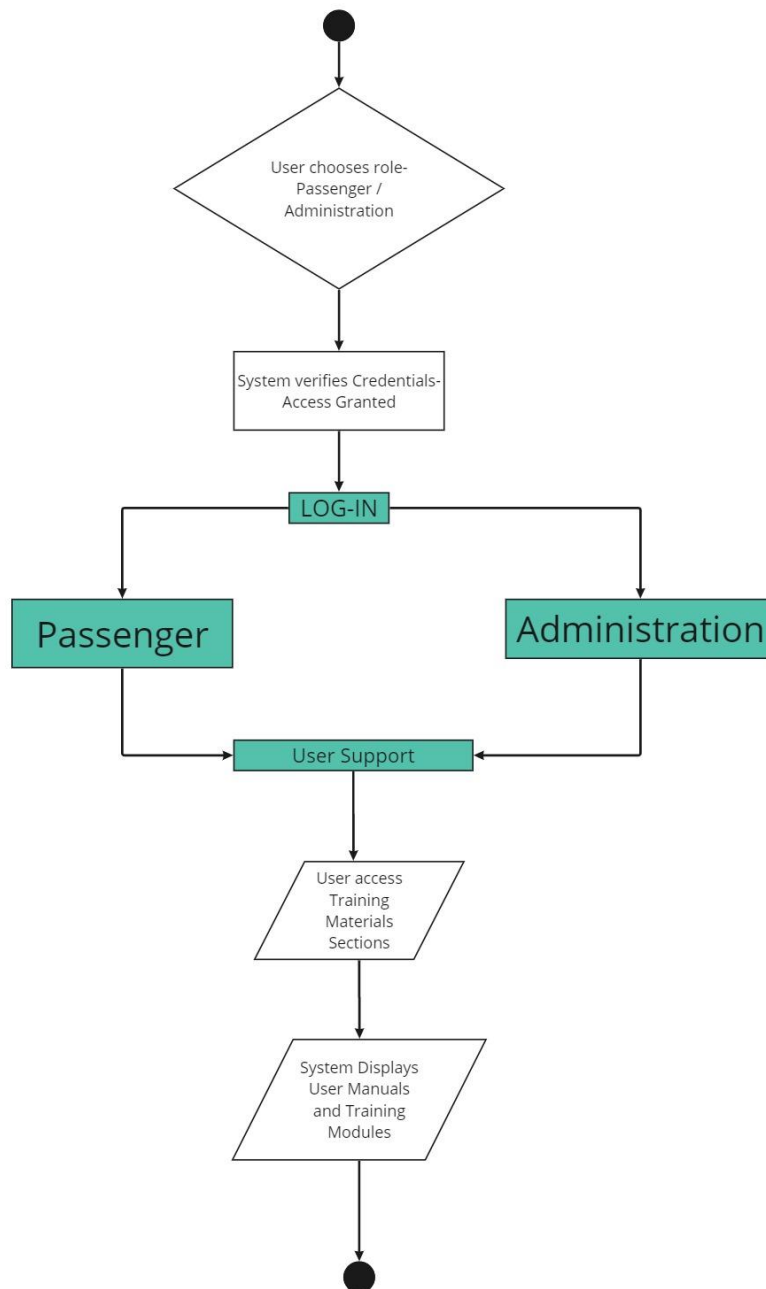
## 3) Activity Diagram



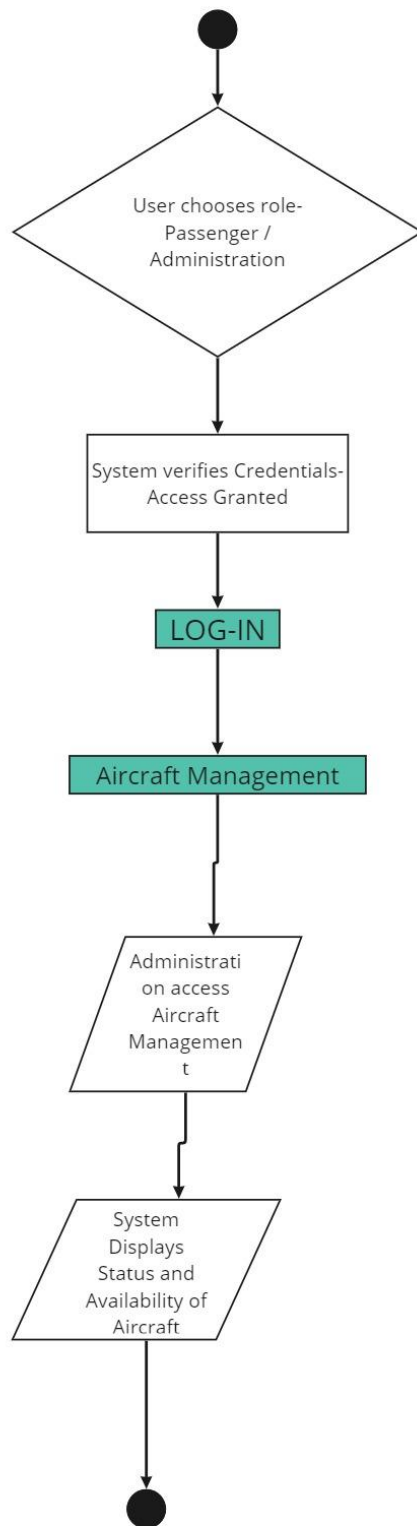
## i) Flight Planning and Scheduling



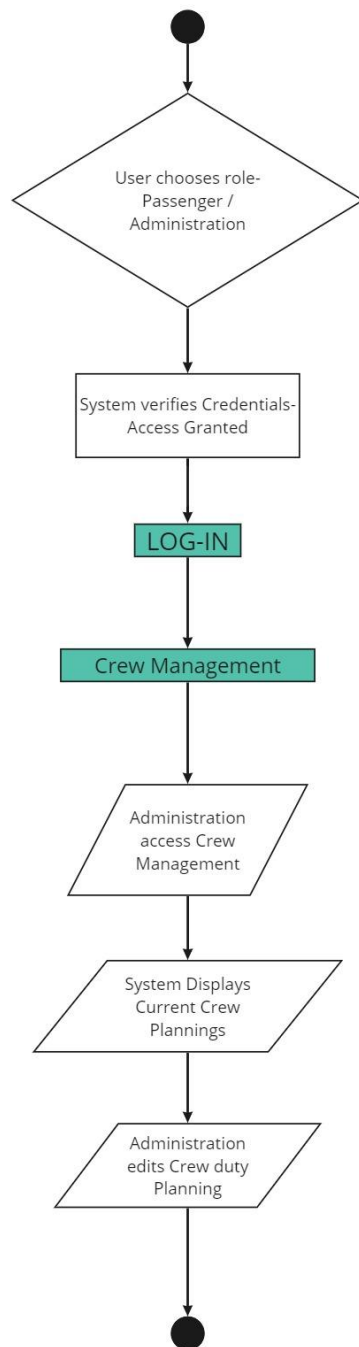
## ii) User Support



## iii) Aircraft Management

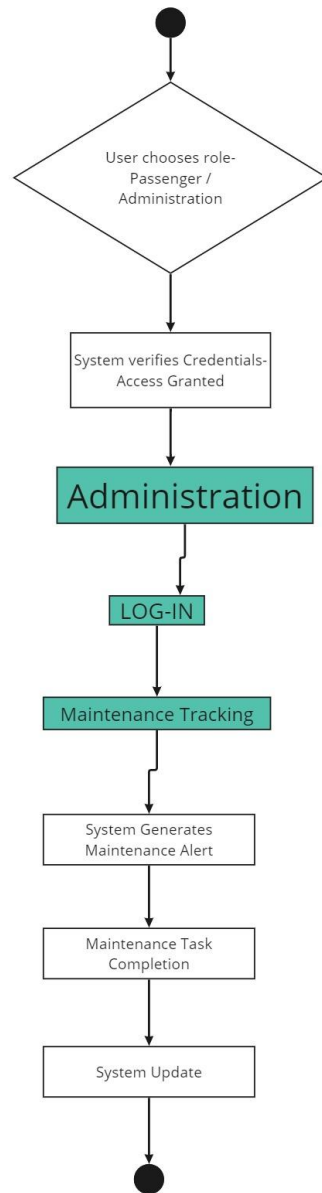


## iv) Crew Management

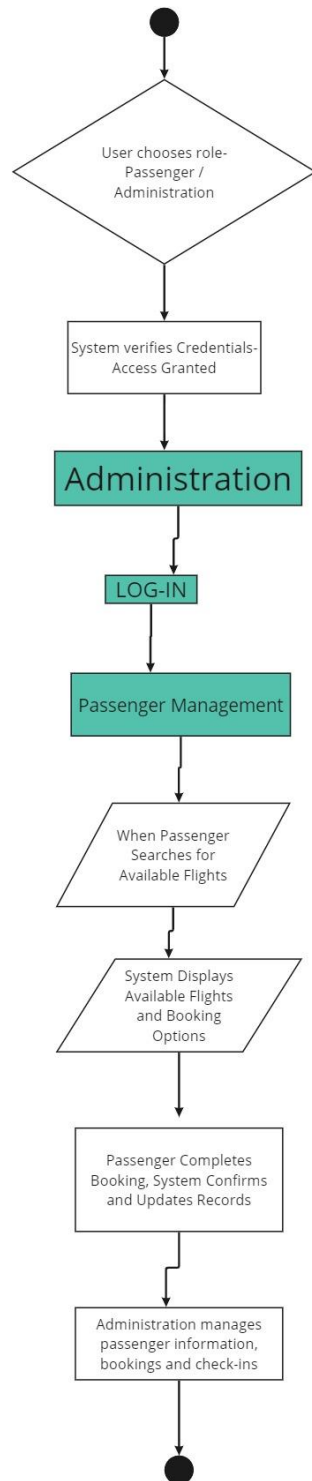




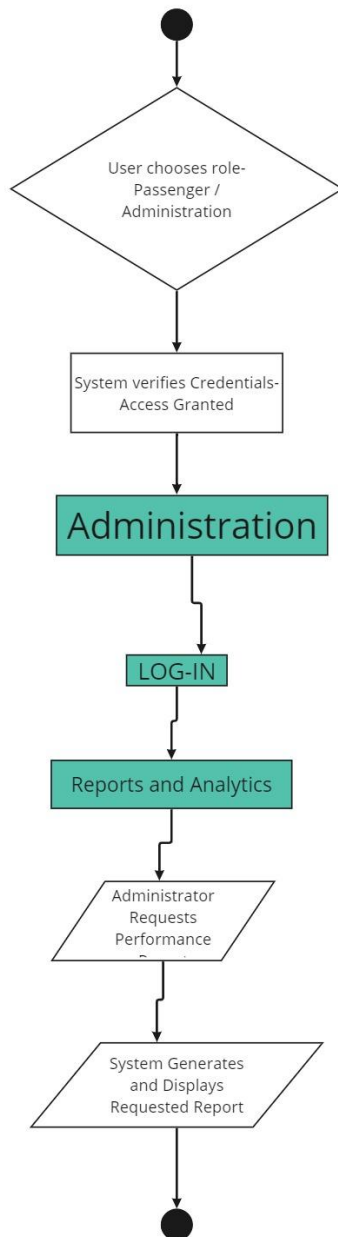
## v) Maintenance Tracking



## vi) Passenger Management



## vii) Reports and Analytics



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**Appendix C: To Be Determined List**

&lt;None&gt;