COMP2211
Software Engineering Group Project
Runway Re-declaration

Group 45

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Footnote: Cover page airplane graphic [3]

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1 Deliverable 1: Project Envisioning - Envisioning Artifacts

1.1 Introduction

Efficient operation and safety are two of the most important aspects of management of commercial airports. In ideal situations, runways operate unimpeded but in reality, runway operations are often interrupted by obstructions like surface damage, broken-down aircraft, etc. In such situations, runways can potentially remain operational, albeit with reduced parameters. Re-calculation of these parameters is lengthy and time-consuming, which impedes timely operation of airfields difficult. Our customer envisions a tool that handles these complicated calculations and presents the results in a manner that is easy to comprehend so as to save valuable time and resources. This document summarises our vision for this project. It includes valuable insights on users, as well as a division of the project into smaller tasks. This document also contains an estimation of complexity of these tasks, division of responsibilities amongst our group members and a brief summary of the tools we intend to use to work on this project.

2 User Understanding

2.1 Stakeholder Analysis

This analysis aims to understand the relationships and dependencies surrounding the Runway Re-Declaration system. By delving into each stakeholder's need, we identify their potential for influence, and the interplay of their needs and challenges within the project [8,9].

Primary Stakeholders:

- **Airfield Operations Manager:** Responsible for managing runway operations in a way that is compliant with safety regulations. Oversee and resolve complex safety and security issues. They interact with the system by providing the system with runway parameters, obstruction details and sending the calculations to airfield safety personnel for for evaluation.

- **Airfield Safety Officer:** Plays a critical role in executing safety operations, emergency procedures, and audits to ensure that the airfield is safe and compliant with set regulations. They view the calculations done by the system, compare with their own calculations and make an informed decision on whether the operations can continue on the obstructed runway. Would benefit from having a visual of the runway.

Secondary Stakeholders:

- **Air Traffic Control (ATC):** Responsible for guiding traffic in and out of an airport, sequencing arrivals and departures in a way that makes efficient use of the runway while minimising accidents. They would use the output of the system, i.e., the recalculated parameters and a visual of the runway.

- **Civil Aviation Authority:** They are a regulatory body that is scrutinises the system for compliance with international safety standards, making sure the system is accurate in its functioning. They would view all functions of the system to ensure it is deployed and used correctly in airports [7].

- **Pilots/Airlines:** Pilots require precise runway data to best help them in safely landing in to or taking off from an airport. They would view recalculated parameters as well as obstruction data so that they can make informed decisions on the benefit of continuing flight operations.

Tertiary Stakeholders:

- **Passengers:** The ultimate end-users, whose travel experience and safety are directly influenced by the system's effectiveness in ensuring timely runway operations. Do not interact with the system directly but benefit from its smooth and efficient operation within the airport eco-system.

- **Local Businesses and Communities:** Economic and social well-being of airport-adjacent communities and businesses is indirectly tied to the efficiency and reliability of airport operations, influenced by the system's ability to maintain smooth runway functionality.

- **Insurance Companies:** Engage with system data to assess risk levels, impacting policy premiums and coverage terms for airlines and airport operations, with a keen interest in mitigating liabilities through enhanced safety measures.

2.2   User Personas

The following personas are designed to provide a comprehensive understanding of the diverse group of individuals who interact with or are affected by the Runway Re-declaration project. We aim to highlight the multifaceted nature of airport operations and the importance of considering various perspectives in project development. These personas will help with empathetic and user-centered design, ensuring that the project's outcomes are beneficial, practical, and inclusive.

Airline Pilot [1]

Captain Maxine is a 45 year old commercial airline pilot with two decades of aviation expertise under her belt. She is certified to fly a double-decker, wide-body airliner, which means all of her flights are international. The airline employing her would like for her to ensure that she sticks to scheduled departure and arrival times to the best of her abilities. Unexpected delays, such as those caused by runway obstructions, are major sources of inconvenience for him. In her twenty years of experience, Maxine has had to undergo multiple training to keep her license current and valid as plane systems have become increasingly advanced. This has inevitably helped her to easily adapt to new software systems being implemented. She would like a system that would do necessary calculations to ensure runways can remain open while still ensuring safety of approaching and departing airplanes.

Air Traffic Controller (ATC) [2]

James is a 47 year old Air Traffic Controller. He has a significant number of years of experience to oversee the clearance and direct movement on runways. He is a strong perfectionist, and has the tendency to make sure landings and take-offs are as smooth as possible. Moreover, he ensures the rest of his team are up to speed and does not want any interruptions. James despises when there is a sudden obstruction that comes in at very late notice. Because of his old age, it ruins his flow of state and finds it difficult to quickly adjust the plane scheduling. He wishes for a system that notifies for any obstructions ahead of time so it's more convenient for him to manage instead of getting any sudden alerts. He finds it very frustrating when the newer staff slack off and don't have the same concentration as he does. As a result this makes him even more stressed and having more difficulty to focus.

Airfield Safety Officer (*ASO*) [4]

Stacey is a 26-year-old junior airport safety officer who is dedicated to ensuring the security and safety of passengers and staff. She has been working for a commercial airline for just over 3 years. Stacey currently assists in collecting data to perform calculations that help ensure that flights take off and land smoothly at their respective destinations. She states that the calculations done are quite time consuming and some of the calculations performed are discarded in the end. Stacey wants a way to determine if the calculations that her and her colleagues perform are worth the time so that they can focus on other tasks.

Airfield Safety Officer (*ASO*) [5]

Andrew is a 55-year old senior airport safety officer who worked in a London commercial airport for over 20 years. He's responsible for the airfield's safety. In his daily work, he and his colleague would routinely collect runway data from the airfield operational team, performs and verify calculations of the runway parameters, ensure the values are accurate and make informed decisions on operations. This task can be task involved and time consuming, therefore Andrew would like a tool that can help him and his colleague with the complicated calculations, and guide them with decision making. However, Andrew found it difficult to familiarise himself with the new systems that the airport has upgraded to, and this has effected his work negatively. He want new systems to provide documentations that can help him to learn how to use the system effectively.

Airfield Operations Manager [6]

Melissa is an 34 years old Airfield Operations Manager, she has a very busy work environment over the maintenance over the airfield overall. She is relatively on of the newer managers that have joined the team and is concerned having to catch up with her colleagues. She sees the workload that the job comes with as she has to juggle between overseeing maintenance activities, coordinating any emergency plans to the other departments and ensuring the safety of the passengers' flight. She is impressed looking at all the more experienced peers as they just know in so little what to do. She's quite worried about how she is able to get to their work ethic and efficiency. She finds it difficult to manage and locate the necessary information to use in operations.

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3 Requirements Planning

3.1 User Stories

User stories encapsulate the functional requirements and expectations of our stakeholders, aligning with the INVEST criteria. Story number codes will be referred to in subsequent sections. Each user story is been given a **number ID** for easier referencing, and a **nickname** for quick reminder of the story's content.

ID	Nickname	User Story
1	Existing Runway	**As an** Operation system administrator at a UK commercial airport, **I want** to configure any existing runway for the UK commercial airport, **so that** I can easily make the system applicable for justifiable layouts and operations specific to the airport I am employed at.
2	New Runway	**As an** Operation system administrator at a UK commercial airport, **I want** the ability to configure the system such that new runways can be added for the UK commercial airport I am working at, **so that** I can edit the computed layout to carry out the necessary calculations with ease.
3	2D Top-down	**As an** airfield safety staff, **I want** to be able to see the 2D top-down visualisations of the airport, **so that** I can easily view the areas on the runway to be able to declare them.
4	2D Side-View	**As an** airport safety staff, **I want** to be able to see the 2D side-on views visualisations of the airport, **so that** I can have a clear view on the various distances on each case for an airplane landing and taking off.
5	Both Views	**As an** airfield safety staff, **I want** to be able to see both the 2D top-down and side-on views visualisations of the airport, **so that** I can have a clear and comprehensive view of the airfield that can help me achieve more accurate planning and monitoring.
6	Auto Calc	**As an** airfield safety staff, **I want** automatic calculation of the new available runway distances when one obstacle is present with its specific dimensions and location, **so that** I can quickly make arrangements and communications to ensure the safe operations.
7	View Calc	**As** airport safety staff, **I want** to view recalculated runway parameters and original parameters side-by-side **so that** I can easily compare them.
8	Obstacle Update	**As** airfield safety staff, **I want** the system to provide a list of predefined obstacles, **so that** I cut-down on the time that would otherwise go into defining a new obstruction every time there is one on a runway.
9	Calc Breakdown	**As** airfield safety staff, **I want** to be able to view a breakdown of the calculation of runway distances, **so that** I can compare them with manual paper results for verification and compliance.
10	XML Import	**As an** operational staff member, **I want** to use XML files to IMPORT details of obstacles and airport data, **so that** I can easily integrate data from other systems.
11	XML Export	**As an** operational staff member, **I want** to use XML files to EXPORT details of obstacles and airport data, **so that** I can easily share data to other systems
12	Side-View Display	**As an** airfield safety officer **I want** the 2D side-on views to display detailed information about the runway and obstacle like runway strip, threshold indicators and threshold designators etc. **so that** I have all the necessary data for confirming that safe runway operations are possible.
13	Top-View Display	**As an** airfield safety officer **I want** the 2D top-down views to display detailed information about the runway and obstacle like runway strip, threshold indicators and threshold designators etc. INCLUDING the runway centre line exclusive for top-down **so that** I have all the necessary data for confirming that safe runway operations are possible.

ID	Nickname	User Story
14	Centreline	**As an** air traffic controller, **I want** the top-down view to display the runway centreline, **so that** I can facilitate air traffic control to accurately guide pilots during takeoff and landing procedures and ensure the alignment of aircraft with the runway.
15	Lower Threshold	**As an** airport safety staff, **I want** lower threshold to always be displayed at a fixed place on the screen (e.g.on the left), **so that** display is consistent with standard procedures and help me to reduces the chance of confusion between different data.
16	Auto Rotate	**As an** air traffic controller, **I want** the ability to make the runway strip on the screen automatically rotate to match its compass heading, **so that** display aligns with the actual geographical orientation.
17	Clear Grade	**As an** airfield safety staff, **I want** the top-down view to show Cleared and Graded areas around the runway strip, **so that** I can make sure these areas are properly maintained and comply with safety regulations.
18	TOC Slope	**As an** air traffic controller, **I want** the side-on view to display the TOCS slope over obstacles, **so that** I can assess and manage the risk to of the airplane during takeoff.
19	ALS Slope	**As an** air traffic controller, **I want** the side-on view to display the ALS slope over obstacles, **so that** I can assess and manage the risk to of the airplane during landing.
20	Select Runway	**As an** operational staff, **I want** to be able to select different runways and thresholds and after selection the views on my screen will be automatically be updated to the specific runway and threshold that I have selected. **so that** I can efficiently manage air traffic based on current runway conditions and availability
21	Notify Action	**As an** operational staff, **I want** receive notifications indicating any actions that have taken place, **so that** I am always up-to-date with changes such as obstacles added, runways re-declared, or values changed.
22	Export Info	**As an** operational staff, **I want** the ability to export visualisations, reports, and operations in formats like PDF, **so that** I can distribute and archive data for stakeholders and regulatory compliance.
23	Collab	**As an** operational team leader, **I want** a system that can supports our teamwork by allowing multi-user collaboration with role-based access, **so that** my team can work simultaneously on the same dashboard while maintaining data security.
24	Error	**As an** operational staff, **I want** a system that can provide clear error messages for my operations, **so that** I can quickly troubleshoot and resolve any issues that arise during use.
25	3D Airfield	**As an** air traffic controller, **I want** that provides a 3D visualisation of the entire airfield, **so that** I can have an accurate, spatial understanding of the airport layout, runway usage, and aircraft positioning to enhance situational awareness and safety.
26	Help Guide	**As an** user of the system, **I want** a documentation that acts as a help guide for learning how to use the system, **so that** I can effectively self-teach and learn to use the system quickly

Table 1: User Stories

3.2 Product Backlog

The Product Backlog serves as a dynamic artifact in Agile development, encapsulating prioritised user stories, features, and enhancements. It evolves iteratively to meet changing requirements. Each user story is been referenced using it's **number ID** and **Nickname**.
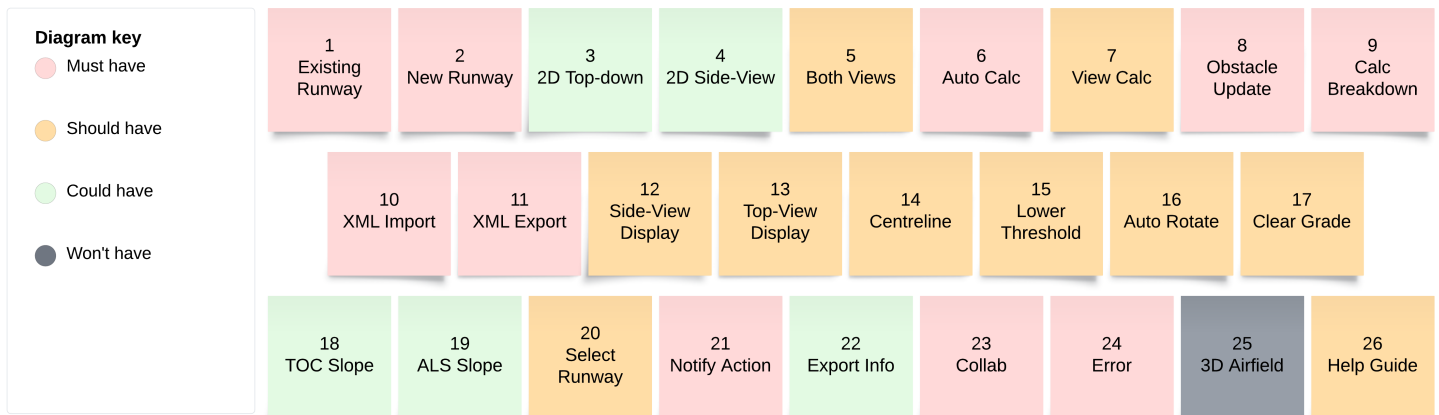

Figure 1: Product Backlog

4 Project Planning

4.1 Increment Plan

The Increment Plan, aligned with our previously defined MoSCoW prioritisation, serves as a structured roadmap for iterative development, focusing on incremental delivery of key objectives in line with deliverable deadlines. The work loads are indicated by **T-Shirt size label (XL - XS)**, with **XL** being user stories with **largest** work loads, and **XS** being user stories with **smallest** work loads.
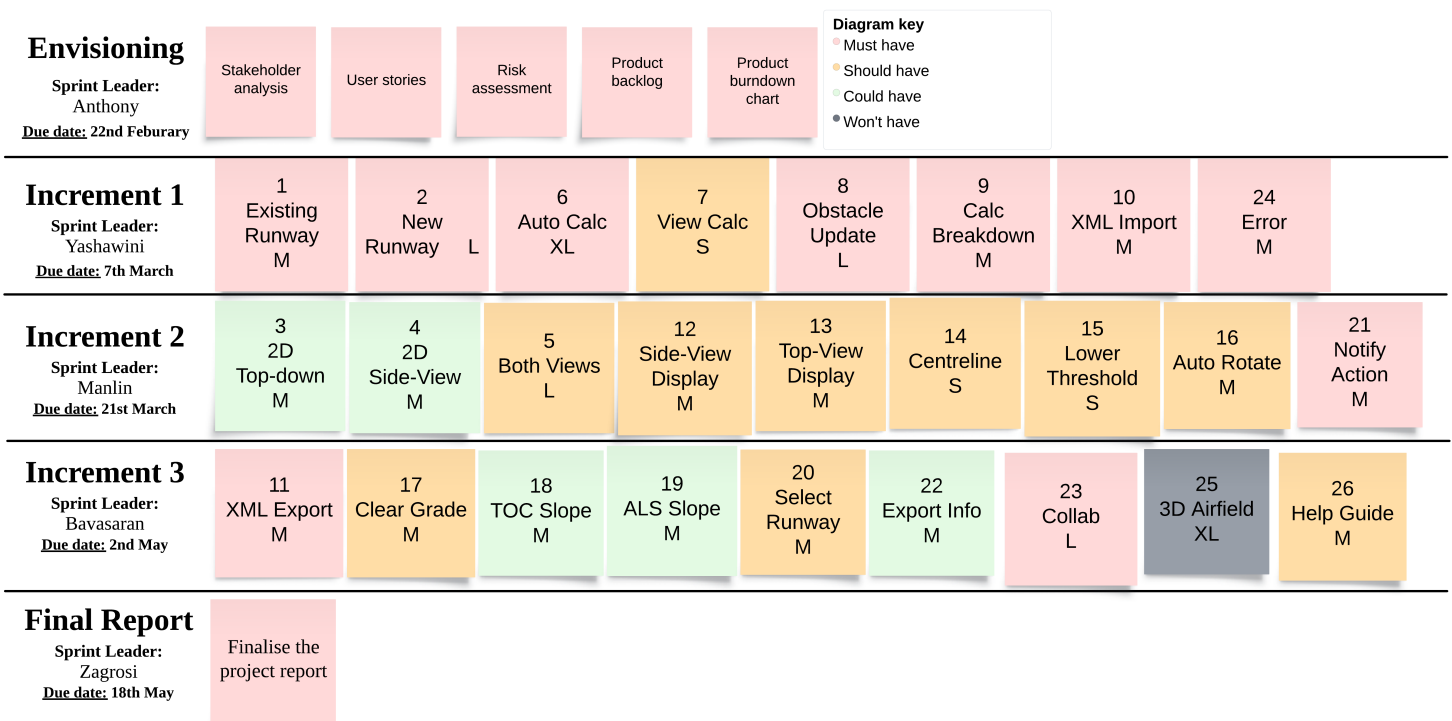

Figure 2: Increment Plan

4.2 Sprint Plan for Next Increment

The following sprint plan outlines the tasks, owners, estimated effort, and priorities for Deliverable 2.

User Story	Sprint Backlog (Tasks)	Member	Complexity	Est. Hours
1: Existing Runway	1. Develop a feature to read the configuration of existing runways. 2. Create a UI to display current runway configurations. 3. Implement functionality to modify the existing runway layout and operations. 4. Ensure the system allows for saving changes specific to the airport configuration.	Anthony	M	5
2: New Runway	1. Build a feature to add new runway configurations to the system. 2. Design a UI that allows the addition of new runways and editing their layout. 3. Integrate a computation module to assist with runway layout calculations.	Anthony, Zagrosi	L	6
6: Auto Calc	1. Develop an automated calculation tool for new available runway distances. 2. Create a function to input obstacle dimensions and locations into the system. 3. Implement real-time updates and communication protocols for the safe operation of runways.	Bav, Yash	XL	10
7: Update Calc	1. Set up a comparison tool to view recalculated runway parameters alongside original parameters. 2. Provide export functionality for the comparison data for reporting and analysis.	Manlin	S	2
8: Obstacle Update	1. Create a database of predefined obstacles with their specifications. 2. Develop a UI to select and update obstacles on the runway. 3. Implement a system to automatically update runway data when obstacles are added or removed.	Manlin, Zagrosi	L	8
9: Compare distances	1. Develop a detailed breakdown view for runway distance calculations. 2. Ensure the system can export calculation data for verification against manual calculations.	Anthony, Bav	M	3
10: XML Import	1. Implement an XML import feature to integrate external data into the system. 2. Ensure the system supports various XML schemas for different types of airport data. 3. Validate the imported data for consistency and accuracy.	Bav, Zagrosi	M	5
24: Error	1. Develop a comprehensive error logging system. 2. Create a UI for operational staff to view and understand error messages. 3. Implement a troubleshooting guide within the system to assist with quick resolution of issues.	Manlin, Yash	M	5

Table 2: Sprint Plan for Deliverable 2
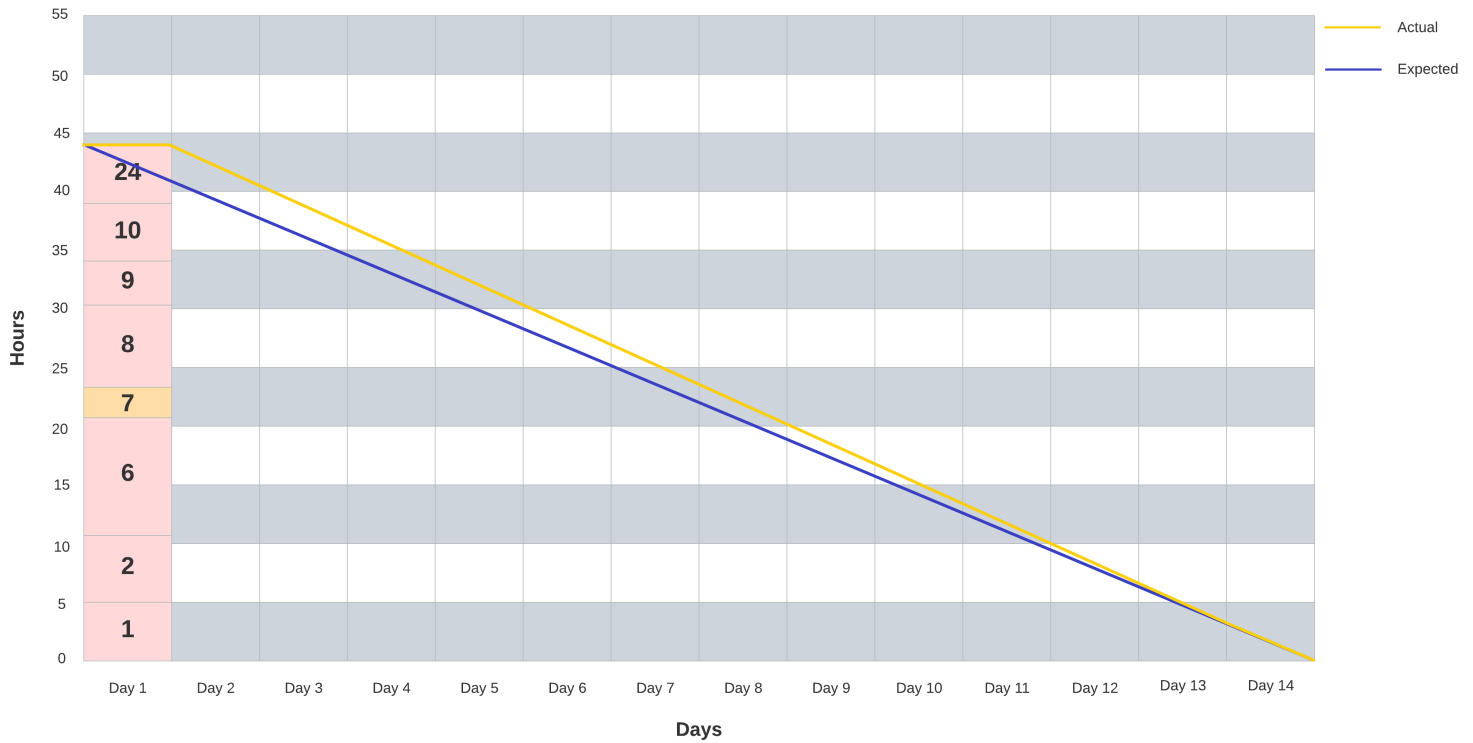
4.3 Day Zero Burn-down Chart

Figure 3: Burn-down Chart

5 Project Setup

5.1 Agile Methods

Programming tools	We intend to use **IntelliJ** for programming as we are familiar with its functions after having used it for various modules in Year 1.
Testing tools	We intend to use JUnit to test our programs. We decided on this as we all had prior experience having used it for our coursework in Year 1.
Version control tools	We plan on using an online repository like **GitHub**. We have previously used an online repository as a part of one of our coursework in Year 1, resulting in less of a learning curve for all group members.
Communication tools	We decided to use **WhatsApp** for everyday communication with our group members and **Microsoft Teams** to keep in contact with our supervisor, as well as to hold online group meetings as we found that our group members were most familiar with using these tools.
Agile scrum tools	We will be using **Jira** to aid scrum method. Also we will use **Lucidchart** for modelling and planning, as we are familiar with it after using it in other modules.

Table 3: Summary of Agile Methods and Tools

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5.2 Risk Analysis

The risk analysis below identifies risks regarding the completion of the runway re-declaration tool group project. As well as identifying risks, the risk analysis takes into account the factors of Probability (P) and Severity (S) of risks and also displays the Risk Exposure (E) which is the Probability x Severity (P x S). The Probability ranges from 1 to 5 where 1 is the lowest probability and 5 is the most probable. The Severity ranges from 1 to 5 whereby 1 is least severe and 5 is most severe. The risk analysis also displays a mitigation strategy for the risk as well as a recovery strategy if said risk occurs.

Risk	P	S	E	Mitigation	Recovery
Lack of participation from group members	3	3	9	Ensure at least 2 meetings are held a week discussing what tasks each member in the group must do.	Discuss in a meeting how team members can make up for lack of participation.
A group member is unable to make a meeting	4	2	8	If a group member is unable to make a meeting, they should notify the team and request to reschedule a meeting time that is acceptable to all team members.	The group member should contribute to the project and will be informed by the team members about what was discussed in the team meeting.
Main sources of communication used between the group are unavailable	2	5	10	Ensure that there are multiple ways to contact every group member via email, etc.	Try and contact via other sources of communication or contact the supervisor/module lead that there is an issue with communication which may delay completion in the project.
Disagreement in how a task in the project should be performed	3	4	12*	Team members who are in disagreement should try to see the problem from different perspectives and come to a verdict via communication.	Ask other members of the team to come to a verdict for the disagreement between the team members via communication.
Missing a deadline	1	5	5	The group should meet at least twice a week and plan how they will tackle making the deliverable before the deadline.	Ensure the deliverable is submitted as soon as possible and make sure the deadline is not missed again.

Table 4: Risk Analysis Table for Runway Re-declaration Tool

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Bibliography

References

[1] California flight academy pilot photo, 2022.

[2] Nav canada air traffic controller photo, Feb 2022.

[3] Creative fabrica - plane taking off graphic, 2023.

[4] East midlands airport aso photo, 2023.

[5] Mag airport careers at london stansted airport, 2023.

[6] Seetec outsource airfield operations manager, 2023.

[7] Civil aviation authority website, 2024.

[8] Sнι, J. Seg project definition: Runway redeclaration, Feb 2024.

[9] Sнι, J. Seg project deliverable 1: Project envisioning, Feb 2024.