

## COMP2211 Deliverable 3: Increment 2

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# 1 Introduction

This report presents the outcomes of the second phase of the COMP2211: Software Engineering Group Project for Group 25. The report begins with an examination of the feedback received during the First Increment and subsequently provides a comprehensive overview of the sprint's design particulars, culminating in a product showcase. Finally, the report discusses the product testing process, a retrospective of the sprint, and a roadmap for the third increment.

## 2 Response to Increment 1 Feedback

On March 15, in the absence of the additional examiner, Group 25 met with their assigned supervisor to discuss the first increment, submitted the previous week. During the meeting, the supervisor outlined various aspects of the increment and offered the group comprehensive feedback. In addition, the supervisor provided general comments on the product as a whole. The following section provides a summary of the feedback provided by the supervisor and outlines the group's response.

### 2.1 Application

#### 2.1.1 Feedback

The group's supervisors expressed satisfaction with the application delivered during the first increment, noting that it was generally comprehensible and provided clear calculations. However, they also provided feedback that certain aspects could be improved upon, specifically regarding the review of obstacles.

During the live demonstration of the application, the supervisor remarked that the group had initially focused on recalculations and obstacle implementation, rather than graphical output. As a result, a placeholder was present in place of graphical output when the user simulated a runway.

Nonetheless, the calculations completed by the group met the expectations of the marker.

To address the issue of obstacle review, the supervisor recommended the inclusion of review object templates within the Review Obstacle scene to clearly delineate the obstacles.

The supervisor expressed admiration for the incorporation of a feature that enables users to begin with a blank "Airport" containing predefined obstacles. However, the supervisor suggested that the addition of a "restore defaults" button would be highly beneficial to allow for the restoration of predefined obstacles in the event of accidental deletion or modification.

Finally, the supervisor expressed satisfaction with the implementation of various XML files and the seamless import, export, and creation of these files within the current version of the application.

#### 2.1.2 Response to Feedback

The group has responded to the feedback by dedicating the current increment to improving the application.

Specifically, efforts were focused on enhancing the visual graphics of the application, which were implemented throughout the second increment, with particular attention to the top-down and side-on views.

Additionally, the group made major improvements concerning the review object templates which were included in the Review Obstacle scene, thus enabling users to easily distinguish between various obstacles. These improvements have been made with the aim of enhancing the overall user experience and ensuring the application's effectiveness in achieving its intended purpose.

### 2.2 Design

#### 2.2.1 Feedback

The design work conducted by the group in preparation for the first increment was well received by the supervisor. The use of various UML tools, including Storyboards, Unified Modeling Language (UML), and Use Case Diagrams, demonstrated a methodical approach to the development sprint and contributed to the creation of a detailed lab book that documented the group's preparation. The supervisors observed that all user stories were covered, and all scenarios were matched with the primary and secondary stakeholders, resulting in prompt and effective progress. Furthermore, they recommended that the group document the LucidChart application, which was used to create the lab book.

#### 2.2.2 Response to Feedback

The group recorded the use of a supplementary software tool called LucidChart alongside the rest of the application. The group utilised Calculation, GUI Testing and further improved it upon the Third sprint which

is briefly described below.

## **2.3 Testing**

### **2.3.1 Feedback**

During the project review meeting, the supervisor expressed appreciation for the thorough, detailed and comprehensive approach taken by the group in testing the application. The group was able to provide a comprehensive set of test cases covering all possible scenarios to evaluate the functionality of the product developed in the first phase.

In addition to the initial testing, the group discussed plans for further testing using the TestFX framework and additional unit tests. This framework enables automated testing of the graphical user interface (GUI) to verify that the application presents information accurately and responds appropriately to user input. In addition, the group intends to develop additional unit tests to strengthen the scope of testing and ensure product quality.

### **2.3.2 Response to Feedback**

No response necessary. The Group will maintain the same standard of work within future product testing.

## **2.4 Planning**

### **2.4.1 Feedback**

The supervisor placed particular emphasis on User Story 18, which underwent redefinition and was subsequently moved from the First Increment to the Second. This particular User Story pertained to the placement of a threshold, featuring the lowest entry on the left side of the screen, as an integral aspect of the visualization process. Additionally, the supervisor observed that the Burndown chart employs a color-coded system to differentiate between tasks categorized as "Musts," "Shoulds," and "Coulds." This classification assists in identifying the level of priority for each task and helps in managing the project timeline effectively.

### **2.4.2 Response to Feedback**

During this sprint, the team made significant progress towards developing the graphics component of the project. Specifically, they focused on positioning the threshold with the lowest entry on the left-hand side of the screen. In addition, the team took into consideration relevant aviation regulations, such as those established by the International Civil Aviation Organization (ICAO). These regulations were carefully incorporated into the design and development process to ensure compliance and adherence to industry standards. Overall, the team's efforts during this sprint have resulted in a substantial advancement towards the project's goals. The team effectively addressed the feedback provided by the supervisor regarding the Burndown chart, leading to successful implementation of task differentiation based on priority. Specifically, the team categorized tasks as "Musts," "Shoulds," and "Coulds" in accordance with their level of importance. This approach not only improved the team's workflow, but also helped to ensure timely completion of critical tasks.

## **3 Design choices**

In the initial phase of development, the system architecture selected was the Model-View-Controller (MVC) pattern. The objective of the current sprint is to enhance the features of the Increment 1 product. It has been determined that making any alterations to the system architecture would not be suitable or required at this stage. Consequently, there are no additional design choices that need to be presented for this increment.

## **4 Design artifacts**

During the second phase of development, the group did not incorporate any supplementary Unified Modeling Language (UML) techniques to enhance the efficiency and design of the product under development. It was deemed that the artifacts generated in the previous report were adequately descriptive, thus rendering any further reflection unnecessary. This approach was adopted based on the belief that the existing UML techniques utilized were sufficiently robust to ensure the successful realization of the product.

## 4.1 User Scenarios

The team made substantial progress in refining the project’s functionality and enhancing its visual appeal. They addressed several previously identified deficiencies in user scenarios and consulted with their supervisor to ensure that stakeholders’ primary concerns were adequately addressed. As a result, the team believes that most stakeholders’ requirements and objectives have been met satisfactorily. Moving forward, in Increment 3, the team will have the opportunity to select and implement an additional functionality to further enhance the application’s performance.

## 4.2 Class diagram

During the marking session for the First Increment, our proposed modifications to the Class diagram were deemed satisfactory by the assessor. As a result, we decided to retain the original Class diagram and focus our efforts on advancing the application’s development.

## 4.3 Product Storyboards

As part of the design process, product storyboards were developed to elucidate the user interface’s anticipated expansion in this iteration. The accompanying storyboards, which are presented below, include a brief description to contextualize and clarify their intended use.

The illustrated storyboards depict simulated user interfaces for each screen within the software. These simulated interfaces highlight the program’s fundamental functionalities and provide a glimpse into how a key stakeholder might interact with the system.

Since we have made changes to the GUI of various screens of our application, we have updated the storyboards from the previous increment’s report to show the new scenes.

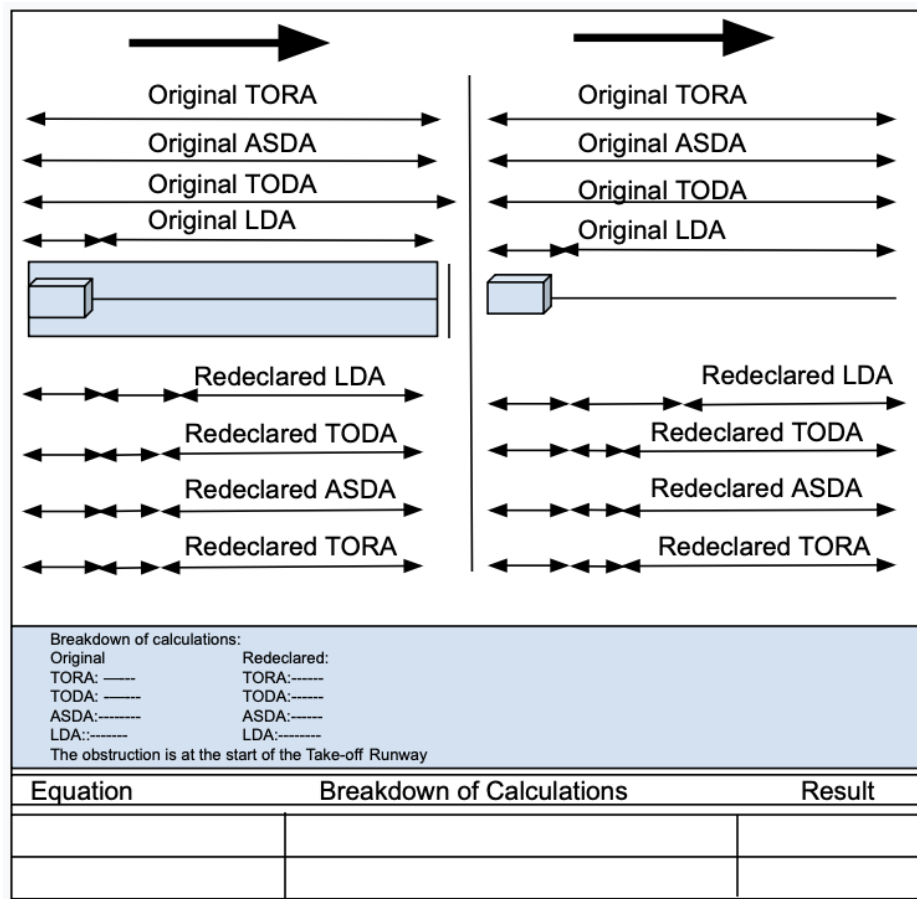


Figure 1: The Top-Down and Side-On Runway View with visualisation of plane and obstacle

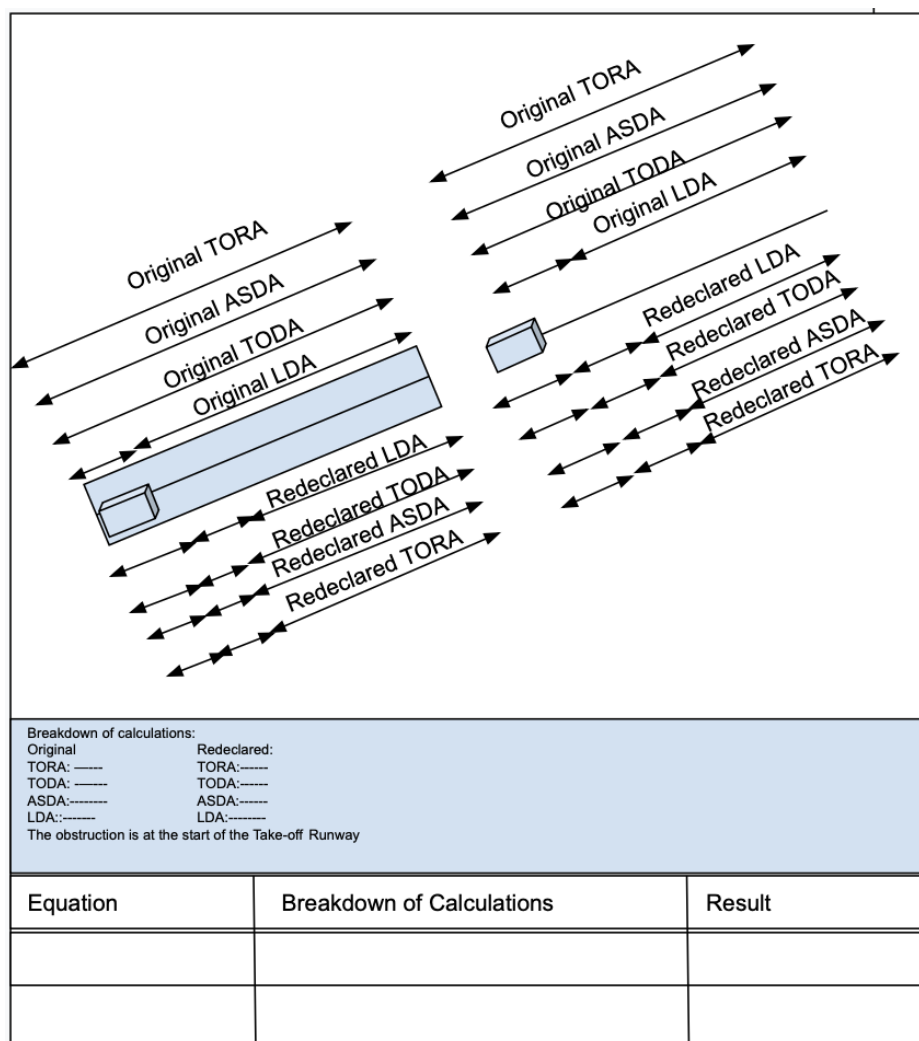


Figure 2: Rotate runway strip

Notifications

Name of Obstacle/ Runway added/ deleted

Type of Obstacle/ Runway added/ deleted

Time of Obstacle/ Runway added/ deleted

<

Time left

Figure 3: Notifications

## 5 Product Adjustments

This section outlines the modifications that were implemented on the first increment of the product, in response to feedback received from the customer during the sprint review meeting. These adjustments were carried out prior to commencing development on the second increment backlog items. The primary objective of these modi-

fications was to enhance the program's overall user-friendliness and guarantee that the customer's specifications were adequately fulfilled.

## 5.1 Response to Feedback

In response to customer feedback, the product has undergone a series of modifications to better align with the customer's requirements. The aim of these adjustments is to enhance the application's functionality and tailor it to better meet the customer's needs.

### 5.1.1 Review Object Templates

In the context of our application, users first report an obstacle as a template separate to its location. Then, the user can add an obstacle template to a runway, and then will give measurements for its position on the specific runway. Because of some confusion, we were advised by our supervisor to rename 'Review obstacles' to 'Review obstacle templates' and make it clear in some other places too that the user is first adding/modifying a template of an obstacle which is separate from the actual obstacle, which only exists when it is placed on a runway.

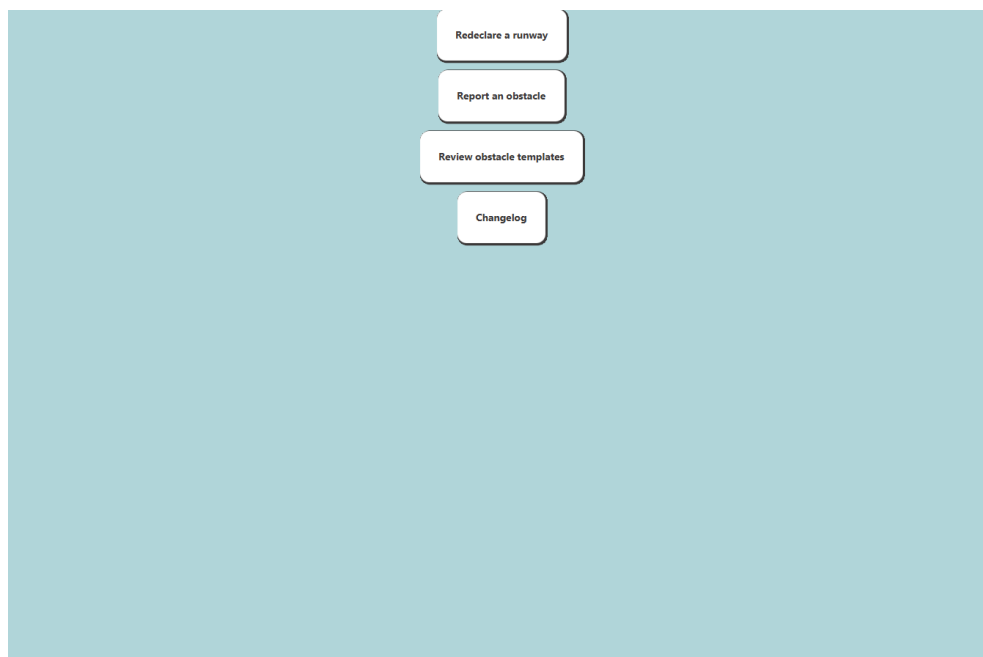


Figure 4: The button that previously said 'Review obstacles' has been changes to 'Review obstacle templates'

### 5.1.2 Reset defaults button

Based on the group supervisor's recommendation, we implemented an additional feature within the Review scene. This feature involves adding a button that enables the user to reset the obstacle templates to the default ones from the XML file. The purpose of this feature is to ensure that users can reset their obstacle templates in case of accidental/intentional deletion/modification.

Back    Reset default obstacle templates

Name: test	Height (m): 67
Modify obstacle template	Delete obstacle template
Name: test2	Height (m): 88
Modify obstacle template	Delete obstacle template
Name: test3	Height (m): 10
Modify obstacle template	Delete obstacle template

(a) Before

Back    Reset default obstacle templates

Name: Shipping Container	Height (m): 3
Modify obstacle template	Delete obstacle template
Name: Small Aircraft	Height (m): 8
Modify obstacle template	Delete obstacle template
Name: Construction Crane	Height (m): 80
Modify obstacle template	Delete obstacle template
Name: Semi-truck Trailer	Height (m): 4
Modify obstacle template	Delete obstacle template
Name: Luggage Cart	Height (m): 2
Modify obstacle template	Delete obstacle template

(b) After

Figure 5: The 'Reset default obstacle templates' button will reset the obstacle templates to the default ones provided



## 6 Product Showcase

The primary objective of the second sprint was to enhance and extend the core functionalities that were previously implemented in the initial increment. In order to achieve this goal, the project team aimed to introduce new features to the system, including a graphical display of runway views (Top-Down and Side-On), a notification system, real-time signals, runway strip rotation, and a zoom capability. These enhancements were designed to provide users with a more comprehensive and user-friendly interface, facilitating improved decision-making and increasing operational efficiency.

### 6.1 Top-Down and Side-On views

In order to implement the top down and side on views, we had to consider the different variations of runway redeclaration, showing different values in different orders depending on whether the plane was landing towards/taking off away from an obstacle or landing over/taking off towards an obstacle. We also had to display the runway designators with the lowest on the left when representing a pair of logical runways. To do this, all of the raw values from the calculations were normalised to the length of the runway being displayed on a JavaFX canvas, this was done with a calculation based on the length of the runway in pixels and the original/TORA value, the length of total runway available to take off on before any recalculation. The original/redeclared values are shown using large arrows on either side and the break down of calculations is shown underneath, using smaller arrows. There still needs to be a key added, this will be completed in the next sprint.

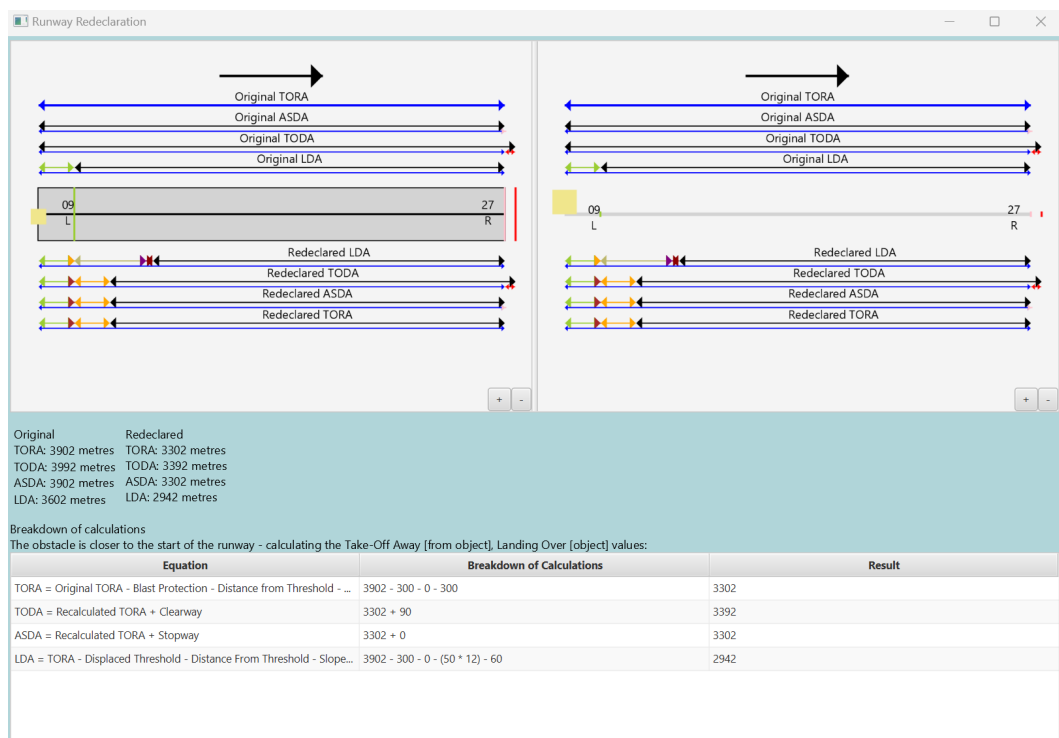


Figure 6: The visualisation of Heathrow example 1a.

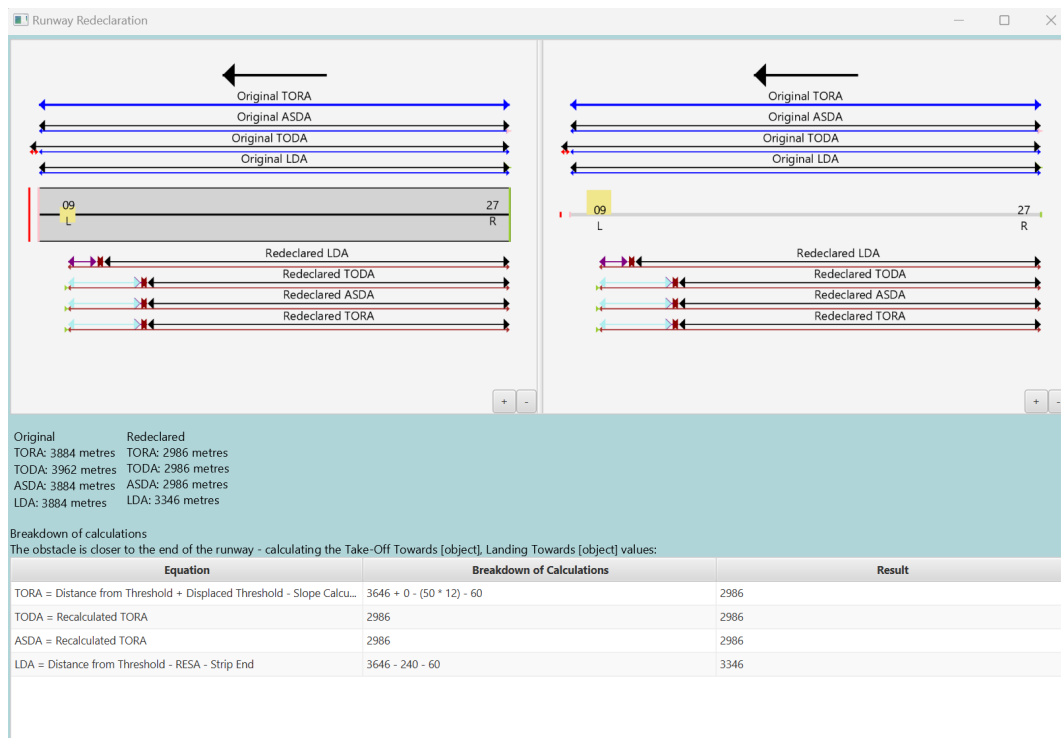


Figure 7: The visualisation of Heathrow example 1b.



Figure 8: The visualisation of Heathrow example 2a.

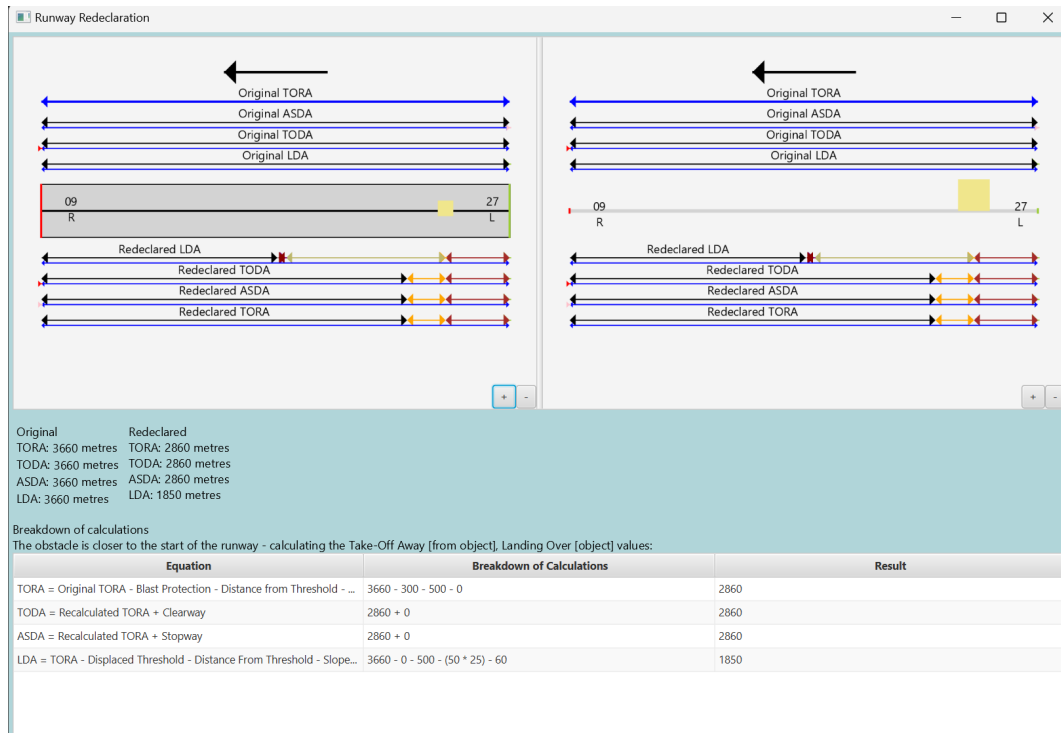


Figure 9: The visualisation of Heathrow example 2b.



Figure 10: The visualisation of Heathrow example 3a.

## 6.2 Changelog and notifications

As a way to log the changes made to a file on the system, we implemented a notification and changelog feature. This is because the product we have created is designed to be used by different users on different systems, although not at the same time. Instead, different users will be able to make changes and be able to access the same configurations by exporting and sending XML files to each other. In order to keep track of what changes are being made by which users, users will now have to enter a username before they can use the software.



Figure 11: Updated start screen with a field for the user to enter their username

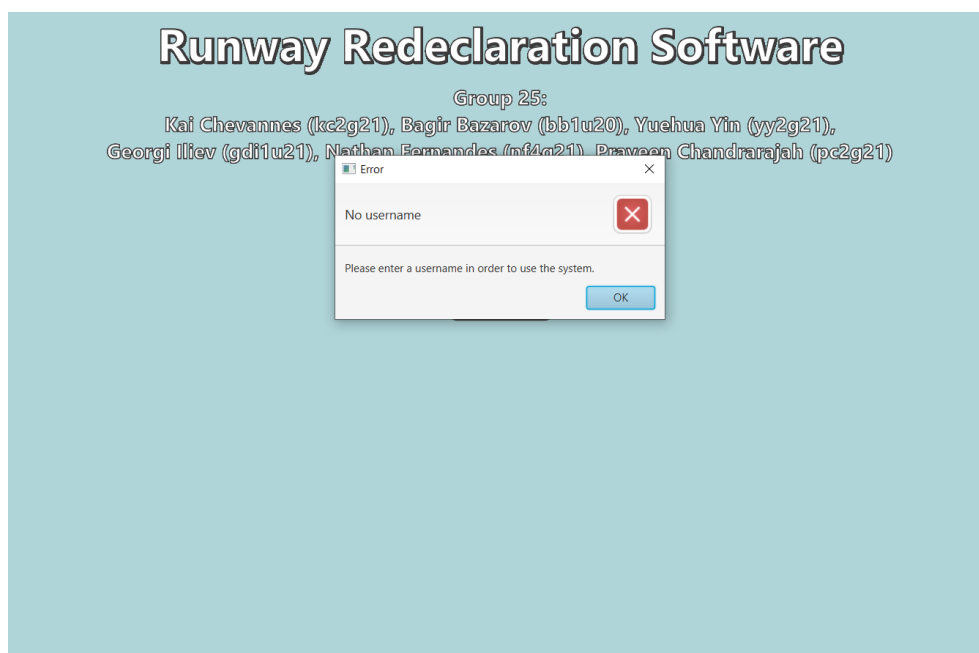
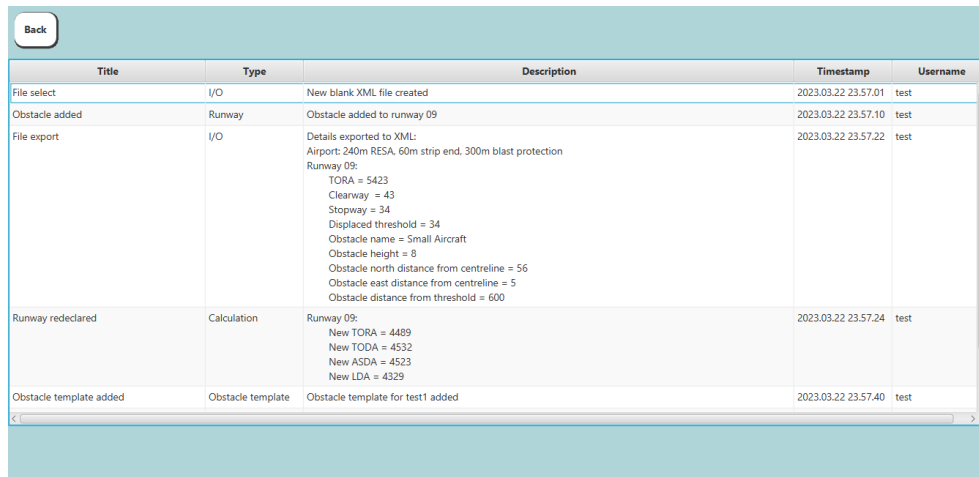


Figure 12: Users will not be able to use the system without providing a username

Changes made (eg. adding a runway, adding obstacle to runway, modifying and adding obstacle templates etc.) are logged and added to the XML file and are displayed in the changelog screen. When exporting to XML, the current contents of the configurations are displayed in the 'description' section. Similarly, when runways are simulated the recalculated values are also displayed. This acts as a way to maintain a record of the history of calculations and of the XML file. Also, the time that changes were made is also logged and displayed.



Title	Type	Description	Timestamp	Username
File select	I/O	New blank XML file created	2023.03.22 23.57.01	test
Obstacle added	Runway	Obstacle added to runway 09	2023.03.22 23.57.10	test
File export	I/O	Details exported to XML: Airport: 240m RESA, 60m strip end, 300m blast protection Runway 09: TORA = 5423 Clearway = 43 Stopway = 34 Displaced threshold = 34 Obstacle name = Small Aircraft Obstacle height = 8 Obstacle north distance from centreline = 56 Obstacle east distance from centreline = 5 Obstacle distance from threshold = 600	2023.03.22 23.57.22	test
Runway redeclared	Calculation	Runway 09: New TORA = 4489 New TODA = 4532 New ASDA = 4523 New LDA = 4329	2023.03.22 23.57.24	test
Obstacle template added	Obstacle template	Obstacle template for test1 added	2023.03.22 23.57.40	test

Figure 13: The ChangelogScene with examples of logged changes showing detailed descriptions, time of change and user

Additionally, when changes are made that will be written to the XML, a popup will appear on the top-right corner of the application to notify the user that the change has been logged. This is so the user knows what is or isn't added to the changelog. The notification lasts for 5 seconds and automatically closes after that period, with a timebar to display how long left until it closes.

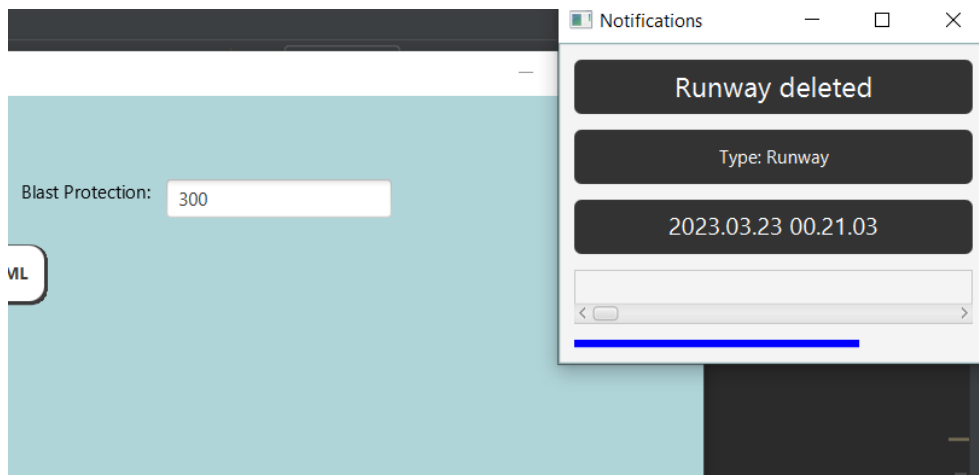


Figure 14: A notification popup on the top-right of the screen to notify the user that their change has been logged

### 6.3 Zoom-in function

Implemented zoom in and out function on top down and side on view displayed in figure 6 and 7. The button '+' will zoom in and button '-' will zoom out with the minimum zoom out set to a full screen. The user can also drag the image around and zoom in at the particular point. The image is set not to come out of the borderline to make sure we do not lose the image.

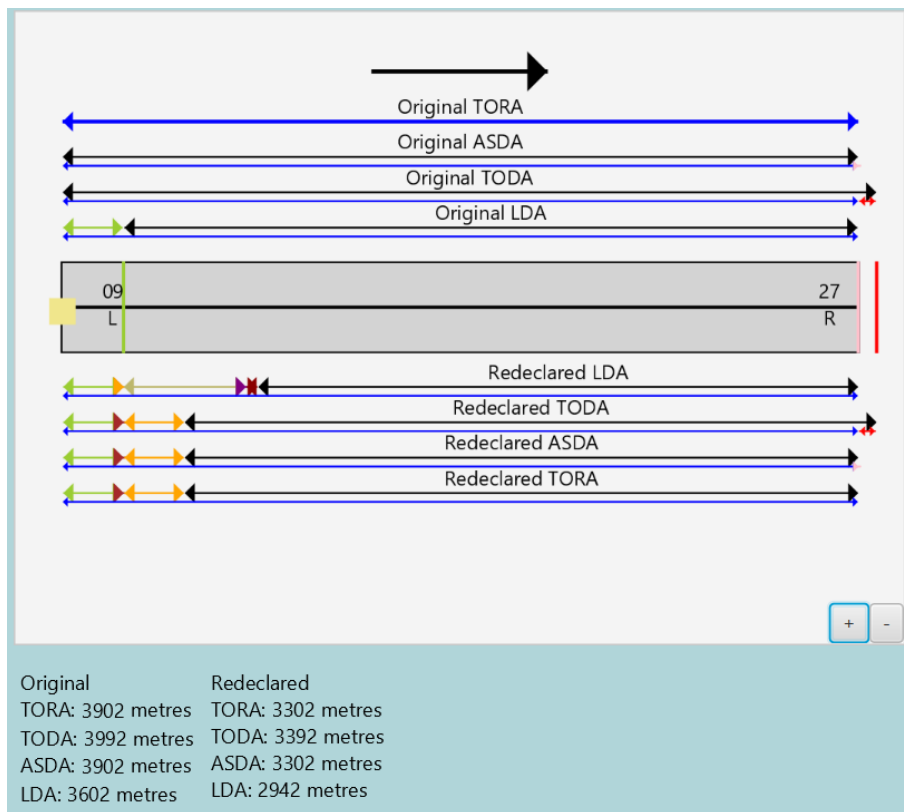


Figure 15: An image of zoom function before zoom in

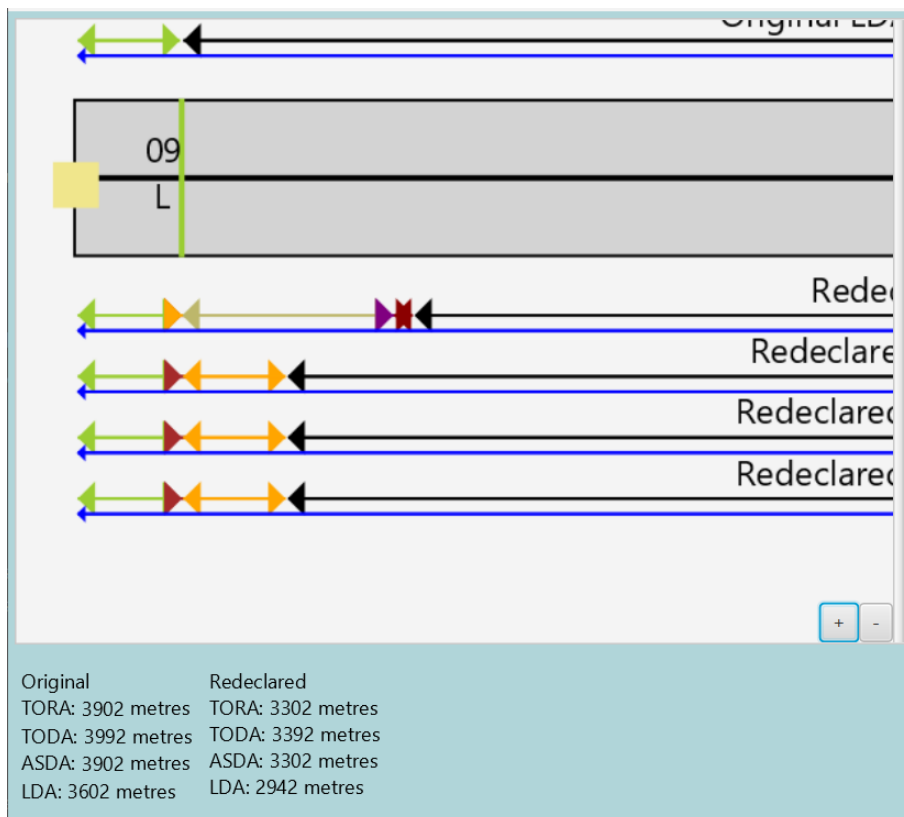


Figure 16: An image of zoom function after zoom in

## 7 Product Testing

### 7.1 User story Testing

- As an air traffic controller, I want the software to give accurate and reliable calculations so that I can feel reassured at work that my instructions to pilots are correct. To test this user story, we performed visual checks on the software's calculation results and compared them with manual calculations. We also ran the software through a series of unit tests to ensure it provided consistent and reliable calculations under varying conditions. Evidence for the unit test exists.
- As an air traffic controller, I want to be able to see the breakdown of the calculations done so that I can check them for myself to ensure they are correct. To test this user story, we verified visually that the software provided a clear and detailed breakdown of the calculations performed. This is accessible when the calculations are performed and all calculations can be seen clearly when the simulation is run.
- As an air traffic controller, I want to be able to configure the runway's dimensions in the simulation so that the calculations done will be correct for a specific runway. To test this user story, we tested the software's ability to edit the runway dimensions. We also verified that the software correctly reflected the new dimensions in its calculations so if a user put a new obstacle or wanted to change anything it would be easy to do so.
- As an airport operations manager, I want to be able to review and correct new obstructions input into the system so that I can ensure the air traffic controllers have the most up-to-date and accurate information. To test this user story, we tested the software's ability to import new obstruction data and make updates as necessary. This was tested in the unit testing section which can be showed. This shows the ambiguous cases of each one of the obstacle and how it shows accurate information.
- As an airport operations manager, I want the system to be configurable to permit its use at any UK commercial airport so that I can ensure the same level of safety at any airport I work at. To test this user story, we verified that the software was configurable for use at multiple airports in two ways, so we have a import XML option which allows you to submit your own configurable airport. Only suggestion that could be made is the option to select an UK airport (pre-defined XML)
- As an airport operations manager, I want the system to be able to import and export data such as obstacles and airports so that I can perform high level analysis to spot trends allowing me to make the airport safer. To test this user story, we tested the software's ability to import and export data, this was ability was checked and verified using our test to see if this works.
- As a runway maintenance worker, I want to easily report airdrome obstacles or damages to the airport operations team so that they can adjust the runway parameters and inform pilots of changes made. To test this user story, we verified that the software provided an easy-to-use reporting system for runway maintenance workers to report obstacles and damages by using drop down menus and predefined obstacles.

#### 7.1.1 Regression Testing

We understand with code coding continuously that we also have to check if previous testing classes are still working from previous increments. And to ensure this - a procedure that has been put into a place is to run tests every time there is a pull from the main branch so all the big changes are noted.

#### 7.1.2 Screenshots of Tests

Below I have provided screen shots of the test passing with the baseScene and of previous test passing in with current code however we will be able to share screen.

```

@Test
void testRunwayWindowLoadScene() {
    TestFxHelper.runOnFxThreadAndWait(() -> {
        BaseScene menuScene = new MenuScene(runwayWindow);
        runwayWindow.loadScene(menuScene);
        Scene scene = runwayWindow.getScene();
        assertNotNull(scene);
        assertEquals(menuScene.getScene(), scene);
        assertTrue(condition: scene.getStylesheets().size() > 0);

        VBox menuVBox = (VBox) scene.lookup(s: ".menu-vbox");
        assertNotNull(menuVBox);

        Button redeclareRunwayButton = (Button) scene.lookup(s: "#redeclare-runway-button");
        assertNotNull(redeclareRunwayButton);

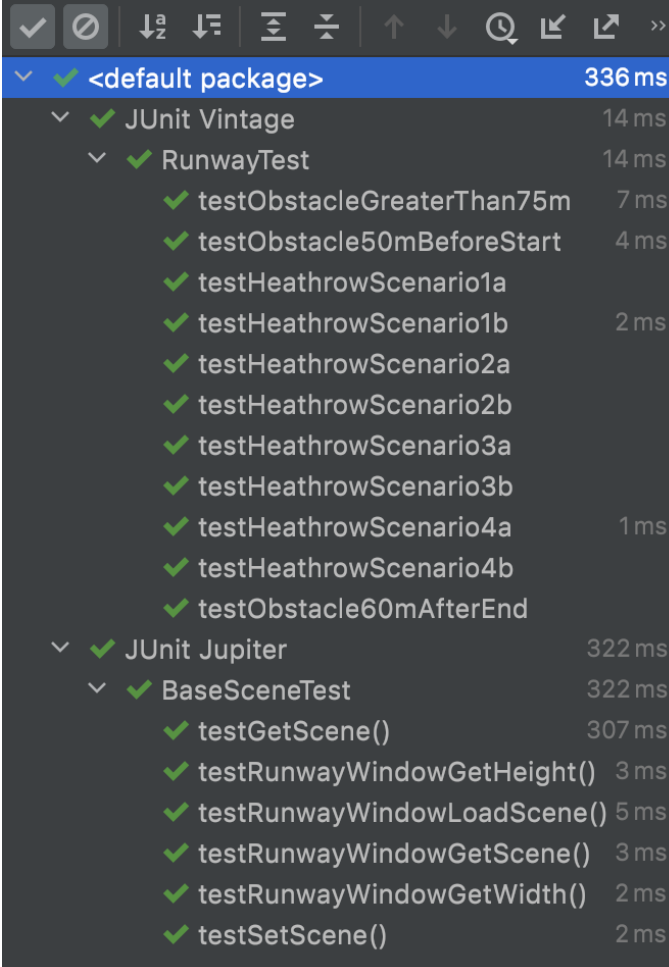
        Button reportObstacleButton = (Button) scene.lookup(s: "#report-obstacle-button");
        assertNotNull(reportObstacleButton);

        Button reviewObstacleButton = (Button) scene.lookup(s: "#review-obstacle-button");
        assertNotNull(reviewObstacleButton);

        Button changelogButton = (Button) scene.lookup(s: "#changelog-button");
        assertNotNull(changelogButton);
    });
}

```

Figure 17: An example of testing JavaFX BaseScene



Test Name	Execution Time
<default package>	336 ms
JUnit Vintage	14 ms
RunwayTest	14 ms
testObstacleGreaterThan75m	7 ms
testObstacle50mBeforeStart	4 ms
testHeathrowScenario1a	
testHeathrowScenario1b	2 ms
testHeathrowScenario2a	
testHeathrowScenario2b	
testHeathrowScenario3a	
testHeathrowScenario3b	
testHeathrowScenario4a	1 ms
testHeathrowScenario4b	
testObstacle60mAfterEnd	
JUnit Jupiter	322 ms
BaseSceneTest	322 ms
testGetScene()	307 ms
testRunwayWindowGetHeight()	3 ms
testRunwayWindowLoadScene()	5 ms
testRunwayWindowGetScene()	3 ms
testRunwayWindowGetWidth()	2 ms
testSetScene()	2 ms

Figure 18: An screenshot of testing passing



## 8 Sprint planning

### 8.1 Sprint 2 Sprint Plan

In this sprint, we ran out of time to implement 3 user stories: 3, 5 and 8. We have started work on all three tasks but encountered unexpected difficulties which meant they have not been completed: we spent more time than expected on implementing top-down and side-on views, and since we wanted to finish a basic version before adding features for user stories 3, 5 and 8 (as these user stories are built around and would be easier to implement with a basic top-down and side-on view already in place), we could not start until we had completed that. Consequently we were left with less time than we wanted to complete these tasks, and have not managed to complete them this sprint. As we predicted that this might happen in our risk assessment in the envisioning, we have no issues with pushing these tasks back into the 3rd sprint to allow us more time to implement these features.

#	User story	Subtasks	Estimated Size	Allocation	Time spent
1 2	As a pilot, I want to be able to zoom in on the system so that I can see more details of the simulation.		L	Main: Yue Backup: Kai Backup: Bagir	8 hours
2	As a runway maintenance worker, I want to receive real-time signals concerning any obstructions or damages on the runway so that I am able to respond quickly and fix the issue which will prevent delays or accidents.	1. Display pop up in real time on the screen 2. Add the change to the changelog screen	S	Main: Georgi Backup: Nathan	6 hours
3	As an accident investigator, I want an option to automatically rotate the runway strip to match its compass heading so that I can orientate myself more effectively.		M	Main: Bagir Backup: Praveen	NOT DONE
4	As an air traffic controller, I want to be able to have top-down and side-on views of a simulation for a plane taking off/landing, so that I can understand how the plane moves in a 3 dimensional space and ensure it does not crash into anything outside of the simulation.		XL	Main: Kai Backup: Yue Backup: Bagir	20 hours
5	As an accident investigator, I want to view the cleared and graded areas around the runway strip so that I can investigate the correct locations.		M	Main: Nathan Backup: Georgi	NOT DONE
6	As a runway maintenance worker, I want to be able to have displayed the standard and the redefined values after recalculations, so that I can compare and double check them and assure the safe takeoff and landing of aircrafts.	1. Show the original values 2. Show the recalculated values	S	Main: Praveen Backup: Nathan	4 hours
7	As a runway maintenance worker, I want the threshold with the lowest entry to always be positioned on the left side of the screen, so that it complies with the aviation regulations, such the ones set by the International Civil Aviation Organization (ICAO).		S	Main: Georgi Backup: Praveen	4 hours
8	As a pilot, I want a visualisation of the plane landing/taking off with an obstacle on the runway on the system, so that I can feel more confident that it is safe to do in real life.		L	Main: Kai Backup: Yue Backup: Praveen	NOT DONE

9	As a flight attendant, I want the runway tool to provide a visualisation of the obstacle on the runway, so that I can have a better understanding of the situation and share the information with passengers in a clear manner.		M	Main: Yue Backup: Georgi	5 hours
10	As an airport operations manager, I want the system to display notifications to the user indicating any actions that have taken place so that I can monitor changes that employees make.	1. Implement notification feature 2. Implement filtering of notification type (e.g. filter by obstacle notification, filter by runway notification) in the changelog screen	M	Main: Praveen Backup: Kai	7 hours

## 8.2 Sprint 2 Burndown Chart

As we did not complete all of the tasks we had planned to complete in this sprint, the burndown chart has been extended. We predict based on our performance that we will be able to finish all the tasks by 26/3 if the pace of work remains the same.

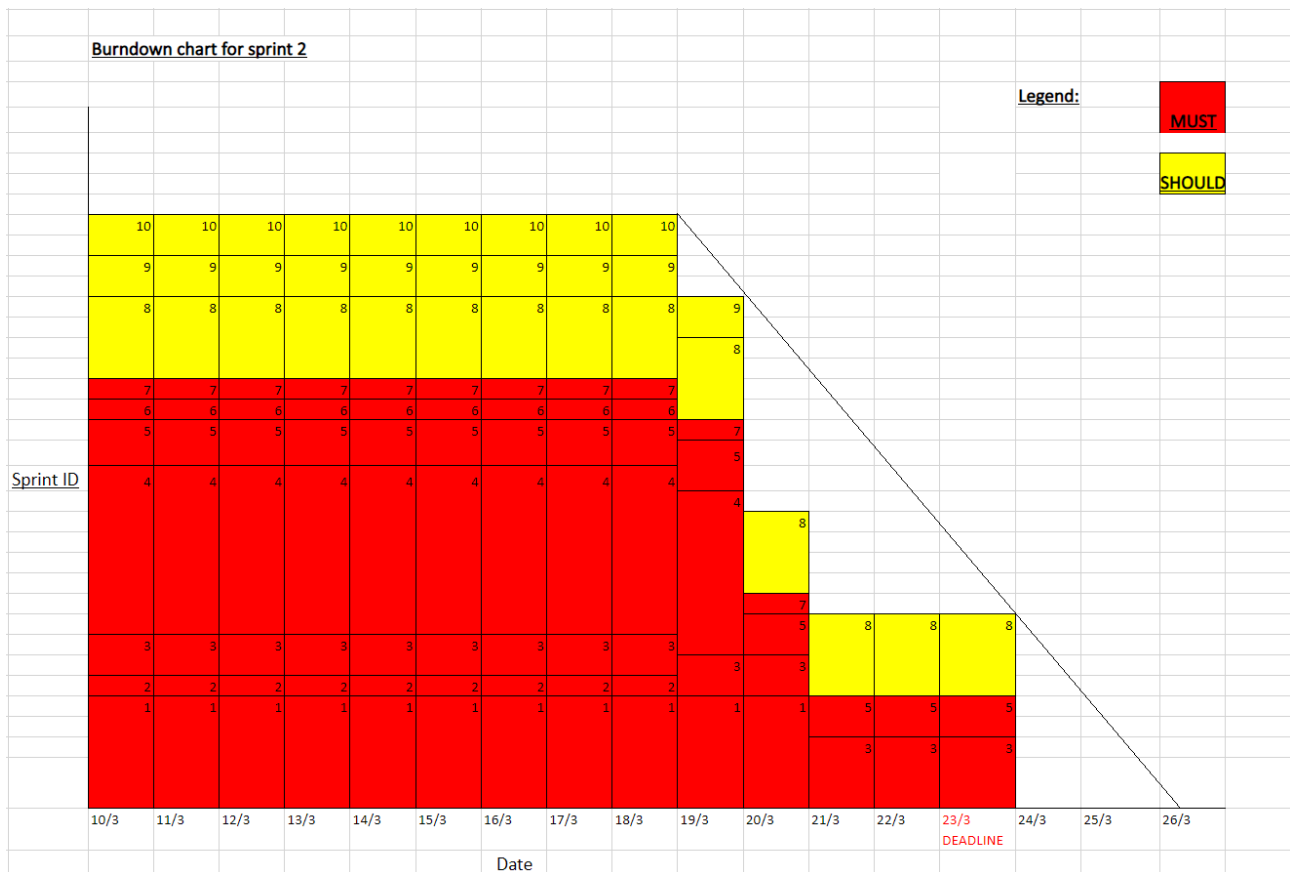


Figure 19:  
Burndown chart showing the sprint ID (user story) left to implement against the date for the second sprint.

## 8.3 Sprint 3 Sprint Plan

For the 3rd sprint, we intentionally assigned less tasks than the first 2 sprints. This is because we predicted that there would be tasks that we would need more time to complete and need to push back to the 3rd sprint (which is indeed what happened), and that there may be more tasks that we need to complete that we will discover as we implement the project. We have also left more time for us to potentially implement more extension tasks if we finish everything before the deadline.

The sprint plan for the 3rd sprint includes the user stories which we assigned to sprint 3 in the increment plan as well as the user stories from this sprint that we had to push back (1, 2 and 4).

#	ID	User story	Subtasks	Size	Allocation
1	28	As an accident investigator, I want an option to automatically rotate the runway strip to match its compass heading so that I can orientate myself more effectively.		M	Main: Yue Backup: Kai Backup: Bagir
2	30	As an accident investigator, I want to view the cleared and graded areas around the runway strip so that I can investigate the correct locations.		S	Main: Georgi Backup: Nathan
3	26	As a flight attendant, I want the runway tool to provide clear and concise instructions on what to do in case the updated parameters do not allow for safe operations, so that I can ensure the safety of the passengers and crew.		M	Main: Kai Backup: Yue Backup: Praveen
4	14	As a pilot, I want to be able to view my flight plan and aircraft information at all times through the system so that I can have easy access to critical information during the flight and make necessary adjustments to the plan if needed to ensure safe journeys.	1. User can enter information about a plane 2. Display information	L	Main:Nathan Backup: Georgi
5	11	As a pilot, I want a visualisation of the plane landing/taking off with an obstacle on the runway on the system, so that I can feel more confident that it is safe to do in real life.		L	Main: Kai Backup: Georgi Backup: Praveen
6	19	As a runway maintenance worker, I want to track my repairs and the time needed for completing them so that I can be more efficient and update the maintenance team only with accurate information.	1. Show when the obstacle was reported on the runway 2. Show the time since it was reported	S	Main: Praveen Backup: Nathan
7	31	As an accident investigator, I want the program to provide a history of where obstacles on the runway were so that I can confirm the locations in real life.	1. Display history of obstacles for each runway 2. Write this data to the XML file	M	Main: Yue Backup: Georgi
8	02	As an air traffic controller, I want to be able to rotate the simulation so that I can see all the details and relay them to the pilot.		M	Main: Kai Backup: Yue Backup: Bagir
9	21	As a runway maintenance worker who is colour blind, I need to be able to distinguish between different colours used in airport markings and signs so that I can safely and accurately perform my job.		M	Main: Georgi Backup: Praveen

## 8.4 Sprint 3 Burndown Chart

As the third sprint includes the Easter holidays, we have split the holiday period into segments of 4 days. Every 4 days we plan to meet and go over what we have worked on and what still needs to be implemented. This is because we have agreed as a team that we will likely be busy with other things during the holiday and will not be able to work on the project every day.

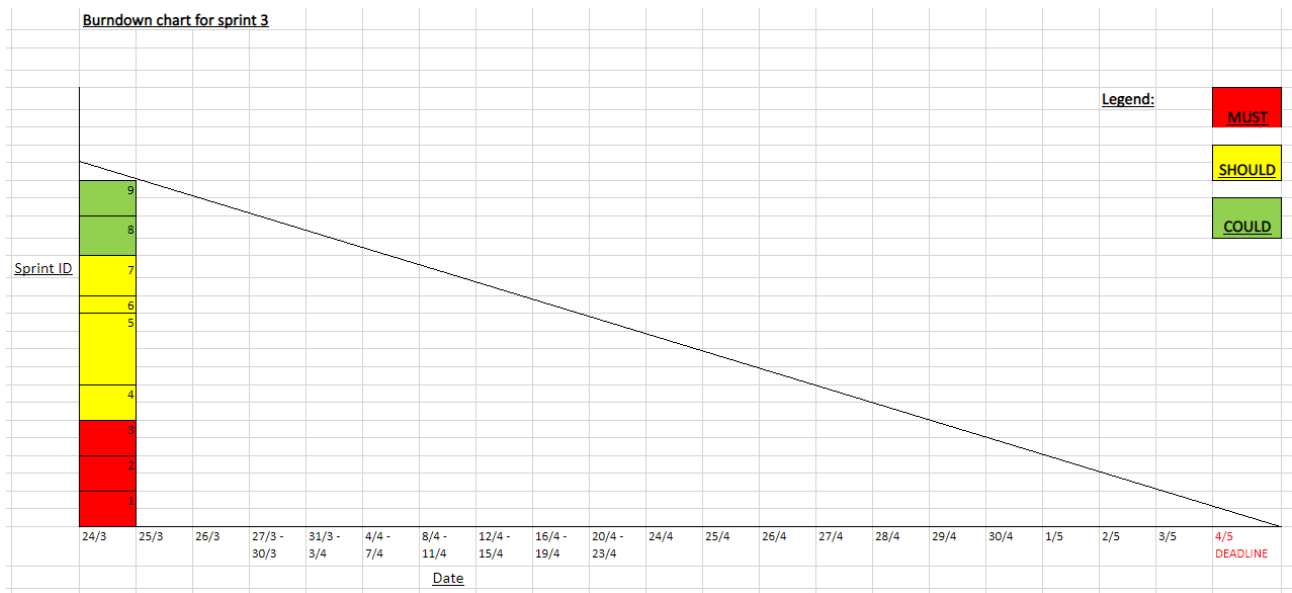


Figure 20:  
Burndown chart showing the sprint ID for the user stories left to implement against the date for the third sprint.