

COMP2211 Deliverable 4: Sprint 3

Group 25:

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1 Introduction

This document summarises the results of the third increment of COMP2211: Software Engineering Group Project for Group 25. The report starts with a presentation of the feedback from the Second Increment which is then followed by detailed overview of the sprint's design choices and a product showcase. Finally, the report concludes the product testing process with relevant changes, a retrospective of the sprint, and a roadmap for the fourth increment.

2 Response to Increment 2 Feedback

On April 24, Group 25 had a meeting with the group supervisor and an extra examiner to go over the second increment that was submitted during the previous week. The supervisors gave the group thorough feedback regarding the various aspects of the increment, as well as general remarks about the overall product. Below is a summary of this feedback and the response of the group.

2.1 Application

2.1.1 Feedback

Overall, the supervisors approved the functionality; however, some parts of the application could be improved. They mentioned that some flows and visualisations in the application were not intuitive and the UI could be implemented better with improved designs overall presentations of the app. This would make the user experience more enjoyable and convenient. One of the remarks from the supervisors was that even though the application is working as expected it looks like a prototype rather than a professional program. The comments provided by the supervisor and examiner are listed below:

- Add back buttons to all windows.
- Increase spacing between buttons to avoid messiness.
- Ensure contrast of colours is good enough in the entire application.
- Use tabular cells so that texts are easy to read and follow.
- Revisit design choices as the app is too simplistic and does not look professional.
- Create legends on runway simulation views for different components.
- Align the components on the redeclare scene to increase professionalism and usability.

2.1.2 Response to Feedback

Following on from the marking session, a meeting was conducted with the customer to discuss the specifics of these changes, such as the colour scheme of the software and the layout of individual screens. After this meeting, all of the changes outlined above were completed to the satisfaction of the customer, this made the product look significantly more professional and also increased the usability, especially for a first time user.

2.2 Design

2.2.1 Feedback

The feedback for the design was similar to that of the application, since a large issue was the UI layout with the existing design artifacts such as use case diagram not requiring change, the storyboards needed to be altered.

2.2.2 Response to Feedback

We redesigned the storyboards after a meeting with the customer with changes to reflect the issues brought up in the marking meeting, particularly this was focused on the layout of the simulation scene and the redeclare scene, making the layouts easier to read by including a more grid like structure and removing clutter e.g. only one runway view is displayed at a time. Other than that, the design work conducted by the group in preparation for the first increment still holds up, with the use of various UML tools, including Storyboards, Unified Modeling Language (UML), and Use Case Diagrams, demonstrating a methodical approach to the development of the software with all user stories being covered, and all scenarios matching with the primary and secondary stakeholders, resulting in prompt and effective progress.

2.3 Testing

2.3.1 Feedback

The supervisors discussed the tests that the group had written for the product functionality as part of the second increment. They commented on the test coverage provided by the tests and suggested that more attention should be paid on regression testing to make sure that prior features are not affected by new ones. Also, the group should focus on explicitly defining acceptance/done criteria for user stories with checklists which would make identifying test cases easier and correct.

2.3.2 Response to Feedback

A meeting with the customer was conducted to discuss and create a thorough acceptance criteria. This acceptance criteria was then used to test our product against, with a mutual notion of "done" allowing us to conclusively tell when user stories were completed.

2.4 Planning

2.4.1 Feedback

Overall, the sprint planning was satisfactory; however, some comments were made by the supervisors which are summarised below:

- The sizes of user stories should be numerical instead of T-Shirt sizing, so that the relation between story points and time spent could be deduced.
- The acceptance and completion criteria for user stories is missing.
- There should be numbering on user stories for easy reference (legends can be used).
- The burndown chart should reflect time spent on user stories which are not yet completed.

2.4.2 Response to Feedback

We have implemented the changes outlined above which includes improvements such as more detailed acceptance criteria for user stories, a more time-reflective burndown chart showing hours worked on each user story and changing the sizes of user stories to hours instead of T-Shirt sizing.

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.

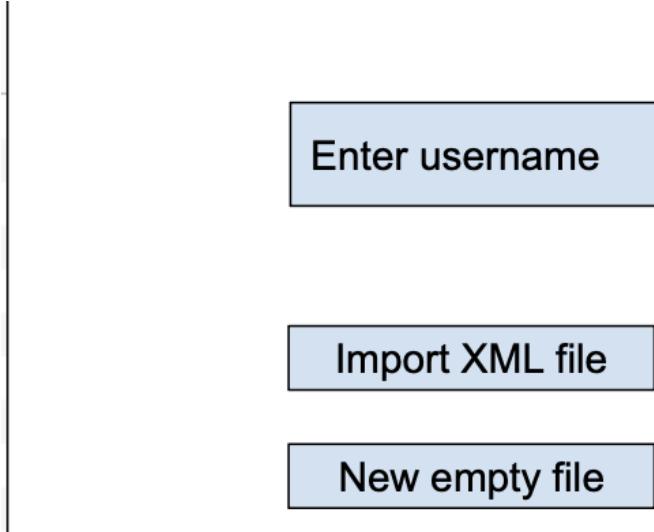


Figure 1: The Storyboard of the starting screen

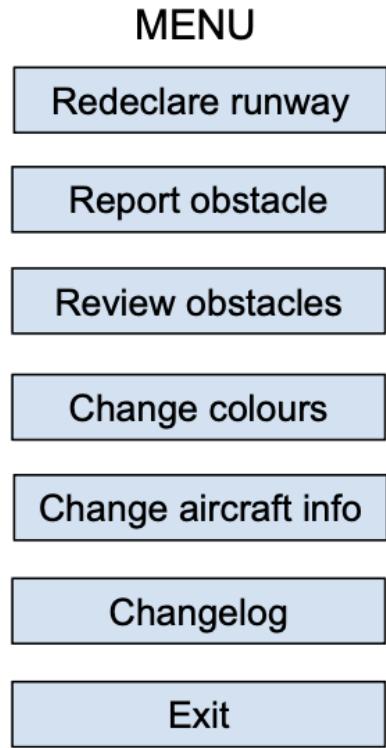
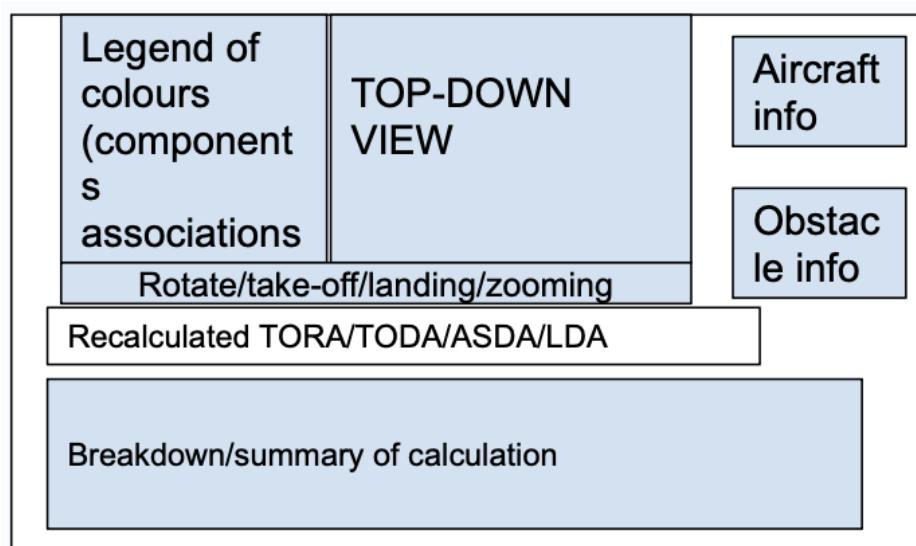


Figure 2: The Storyboard of the main menu

<p>Airport details: RESA, blast protection etc.</p> <p><input type="button" value="Add runway"/> <input type="button" value="Export to XML"/></p>	
<p>Runway details:</p> <p>Designator: <input type="text"/> Length: <input type="text"/> Clearway: <input type="text"/> Stopway: <input type="text"/> Displaced Threshold: <input type="text"/></p> <p><input type="button" value="Simulate runway"/> <input type="button" value="Add obstacle"/> <input type="button" value="Delete runway"/> <input type="button" value="Check obstacle history"/></p>	
<p>Airport details: RESA, blast protection etc.</p> <p><input type="button" value="Add runway"/> <input type="button" value="Export to XML"/></p>	
<p>Runway details:</p> <p>Designator: <input type="text"/> Length: <input type="text"/> Clearway: <input type="text"/> Stopway: <input type="text"/> Displaced Threshold: <input type="text"/></p>	
<p>Obstacle details:</p> <p>Obstacle Name: <input type="text"/> Height: <input type="text"/> Width: <input type="text"/> Length: <input type="text"/> North from centreline: <input type="text"/> East from centreline: <input type="text"/> Distance from threshold: <input type="text"/> Estimated clearance time: <input type="text"/> <input type="button" value="Select an obstacle"/></p> <p><input type="button" value="Simulate runway"/> <input type="button" value="Remove obstacle"/> <input type="button" value="Delete runway"/> <input type="button" value="Check obstacle history"/></p>	

Figure 3: The Storyboard of the Runway Redeclaration



Breakdown/summary of calculation



Original TORA



Original ASDA



Original TODA



Original LDA



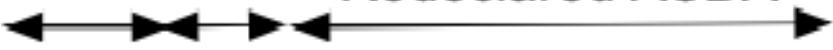
Redeclared LDA



Redeclared TODA



Redeclared ASDA



Redeclared TORA



Figure 4: The storyboard of Top-Down view simulation of the Runway

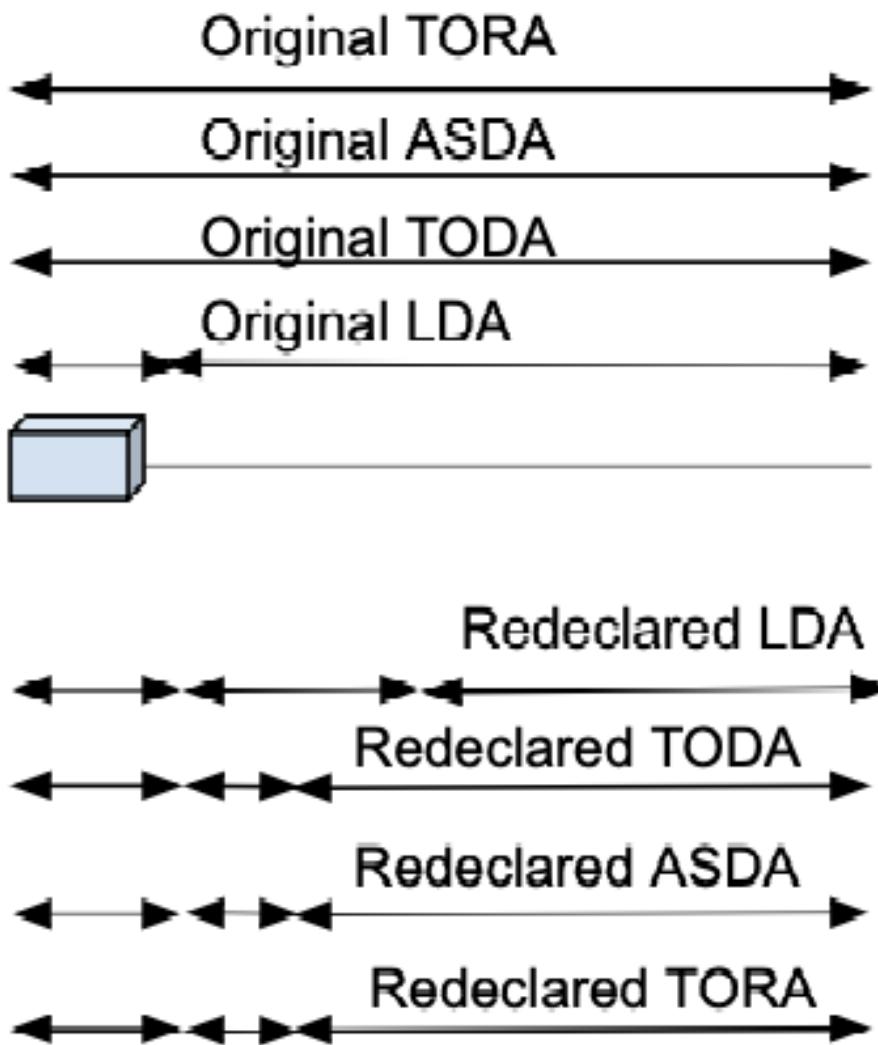
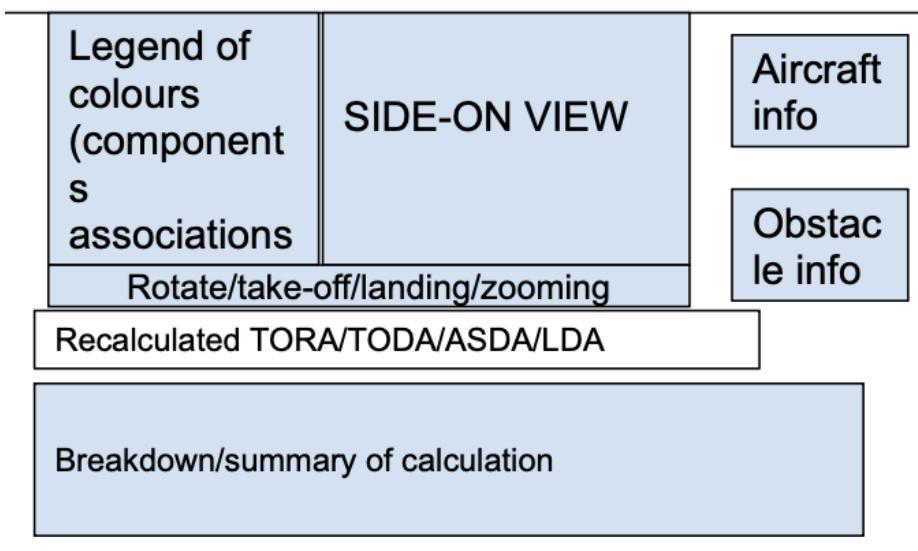


Figure 5: The storyboard of Side-On view simulation of the Runway

Report object on runway

Name:	<input type="text"/>
Height:	<input type="text"/>
Width:	<input type="text"/>
Length:	<input type="text"/>

Add

Figure 6: The storyboard of the Object report screen

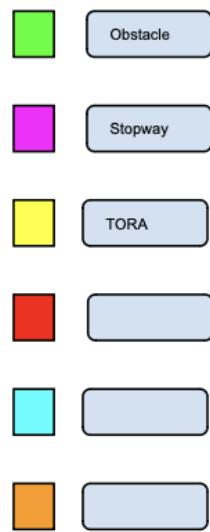


Figure 7: The storyboard for the screen allowing changing the colour of a given component

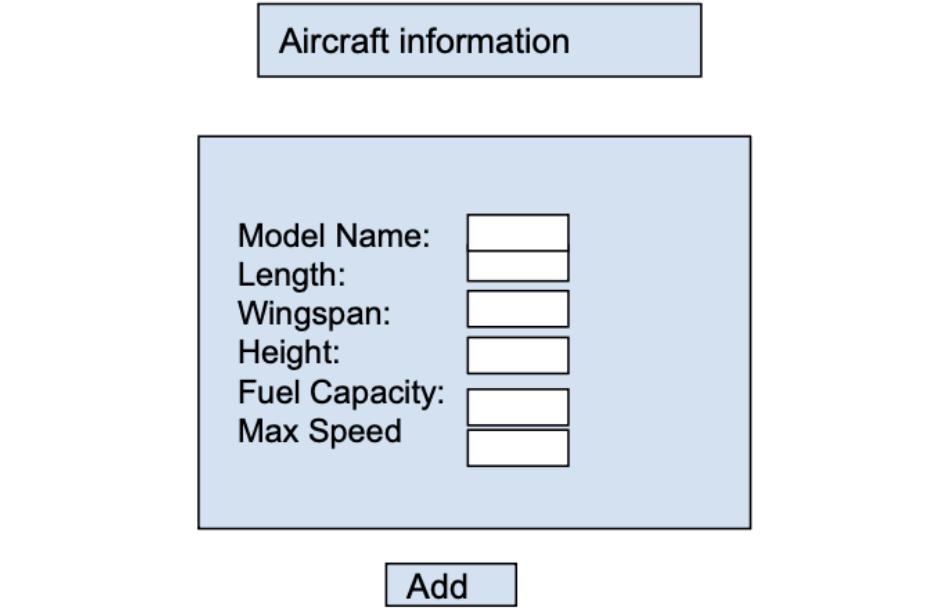


Figure 8: The storyboard for the screen allowing changing the information of a given Aircraft

4 Design artifacts

4.1 Persona Scenarios

Air traffic controller (Julia, 35):

- Julia opens the runway redeclaration tool.
- Julia imports an existing airport XML file or starts a new blank one .
- If starting a blank airport, the system will have a set of predefined obstacles, otherwise there will be obstacles added specifically to the file selected from a previous use of the tool.
- Julia selects the redeclare obstacle view.
- Julia inputs the airport details.
- Clicks the "Add runway" button
- A new runway section shows up, with space for runway details such as TORA, Clearway and stopway.
- Clicks the "Simulate runway" button
- A runway simulation opens, displaying the runway with a top down view, side on view, with options to rotate and zoom into the visualisations. Underneath the visualisations will be a list of original values and then next to it the recalculate values for the redeclared runway. Finally, underneath that will be a breakdown of calculations, allowing Julia to check her calculations to the system.
- Julia closes the simulation and clicks the "Add obstacle" button for the runway that was created earlier.
- A new drop down menu is shown which allows her to select an obstacle from the obstacles stored in the XML file being worked on.
- Julia selects the "Small Aircraft" obstacle which has a corresponding height.
- Julia inputs the remaining data about the obstacle such as distance from the start of the runway.
- Julia clicks the "Simulate runway" button and the same window from before is brought up, but this time there is a visualisation of the object on the runway with an associated calculation breakdown.
- Julia closes the simulation
- Julia clicks the "Add runway" button and adds a new runway as before.
- Julia clicks the "Export to XML" button which will export all of the runway information to an XML file, this can then be imported the next time that the system is used.
- Julia navigates back to the menu screen by using the escape key or clicking on the back button.
- Julia clicks on the "changelog" button
- All of the changes have been logged successfully, allowing her to look back on previous calculations.

Runway Maintenance Worker (Josh, 46):

- Josh opens the runway redeclaration tool.
- Josh imports an existing airport XML file or starts a new blank XML file.
- Josh selects the report obstacle view.
- Click "Report new obstacle".
- Screen to report an obstacle appears with things about the obstacle such as name, width, height, etc.
- Click "Save obstacle".
- Obstacle is saved to the system.

Airport Accident Investigator (Sarah, 55):

- Sarah opens the runway redeclaration tool.
- Sarah opens an existing XML file for an airport she is working on.
- Sarah clicks the "Redeclare" button and then "Simulate" on the runway she is investigating.
- Sarah then views the visualisation of the obstacle to understand the layout of a potential incident.
- Sarah exits out of the simulation and goes back to the menu using the escape key or clicking on the back button.
- Sarah clicks the "Changelog" button.
- Sarah can now view a history of obstacles and where they have been to help her investigation.

Pilot (Michael, 56):

- Michael opens the runway redeclaration tool.
- Michael opens an existing XML file for the airport they will be landing at.
- Michael clicks the "Redeclare" button and then "Simulate" on the runway he is going to be landing on.
- Michael can now use the values outputted to safely plan his landing.

Flight Attendant (Emily, 25):

- Emily opens the runway redeclaration tool.
- Emily opens an existing XML file for the airport they will be landing at.
- Emily clicks the "Redeclare" button and then look for the runway they will be landing on.
- Emily can now use the obstacle shown by the system combined to advise passengers about why their landing may be delayed.

Airport Operations Manager (Robert, 44):

- Robert opens the runway redeclaration tool.
- Robert opens an existing XML airport document or begins a blank one.
- Robert selects "review obstacle" button.
- Notifications of new reported obstacles by the airport investigation team will appear in the top right of the screen.
- Either click on the notification or click on the "Review Obstacles" view.
- For each obstacle, Robert can verify measurements and remove any obstacles that are not appropriate, this obstacle will now be removed from the system.
- Robert will also have the option to modify an obstacle if there has been a typo for example and a height has been set to 100 metres instead of 10 metres.
- Robert clicks the "Modify obstacle" button
- A pop-up window will come up with fields to change.
- Robert changes the values as appropriate and clicks on the "Save" button.
- The updated obstacle will now be saved to the XML file, ready for the air traffic controller to use.
- Click the "changelog" button .
- Robert can now view all previous changes to the system, with options to filter by notification types such as "Obstacle" or "Runway"
- This allows him to check that the air traffic controllers are performing their jobs appropriately.

4.2 Use Case diagram

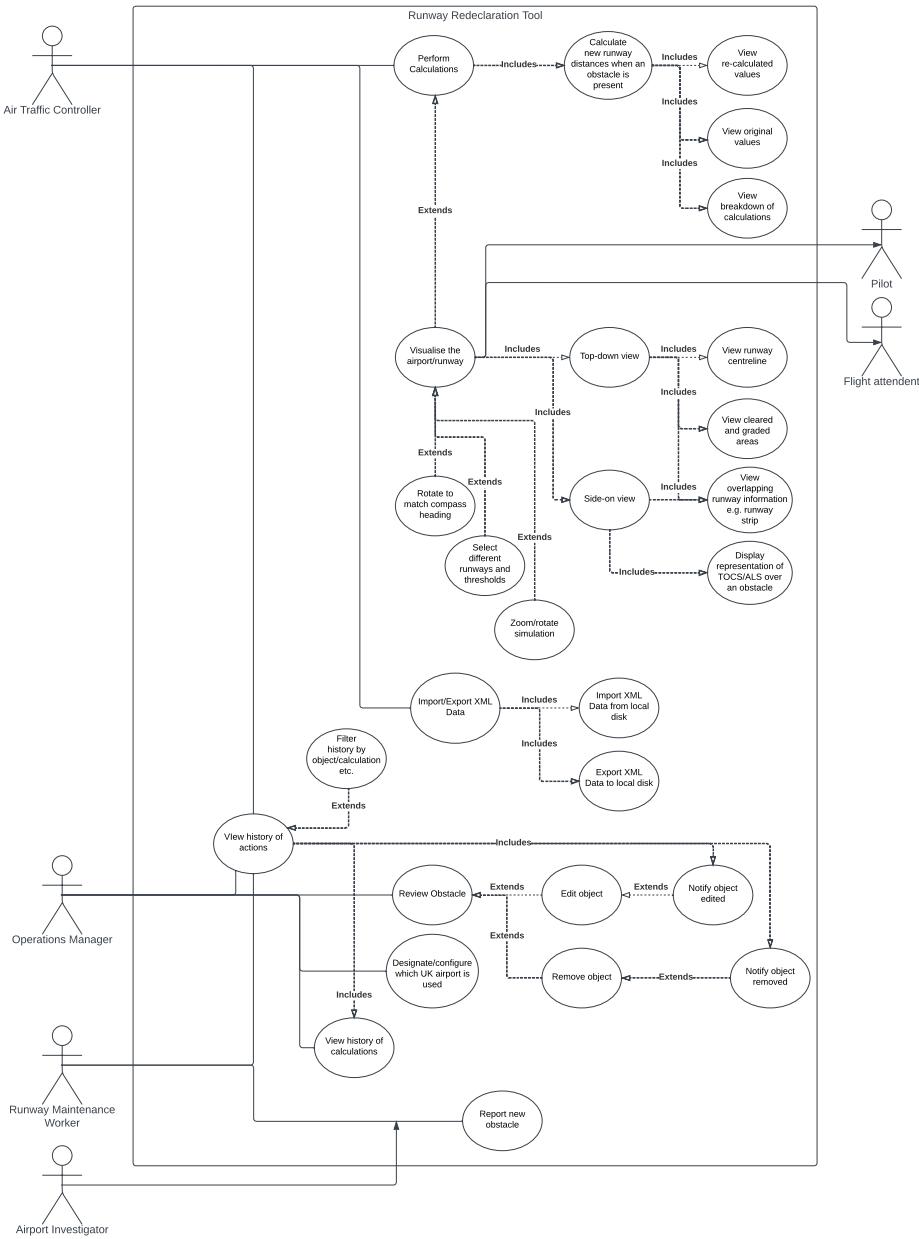


Figure 9:

UML use case diagram showing stakeholders interacting with the system. Figure can be zoomed in for better quality.

4.3 Class diagram

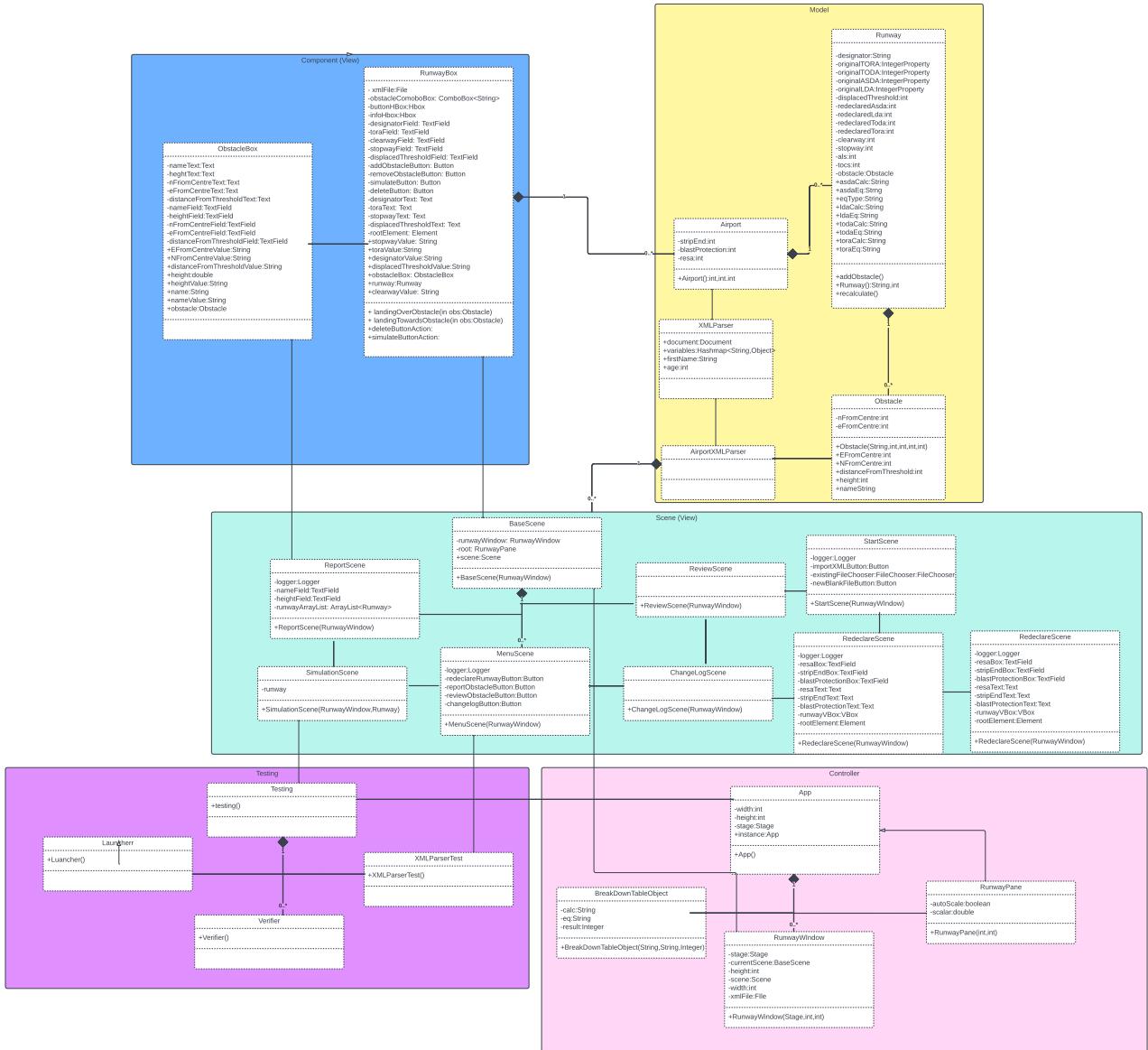


Figure 10: UML class diagram showing the classes implemented and the relations between them. Figure can be zoomed in for better quality.

5 Product Adjustments

5.1 Response to Feedback

As outlined previously, we added all of the changes surrounding the issues brought up in the marking meeting with our second supervisor. Furthermore there was some more feedback from our customer:

- Make sure the units are correctly showed in all instances.
- Make the runway top-down and side-on view buttons highlight green to indicate which one is currently selected.
- Bold the majority of text to improve readability.
- Make sure the text colour and background colour contrast to improve readability.
- Make the first column of tables darker to improve readability.

5.2 Improvements

These additional changes were also taken into consideration and all were implemented during the final sprint to the satisfaction of the customer. Furthermore, final bug fixes and final verification was implemented, this means that invalid inputs are caught with helpful error messages, with none of these inputs resulting in the software suspending. This again adds on to the professionalism of the software and final polish.

6 Product Testing

6.1 Scenario Testing

Air traffic controller (Julia, 35):

- Julia opens the runway redeclaration tool.
- Julia imports an existing airport XML file or starts a new blank one .

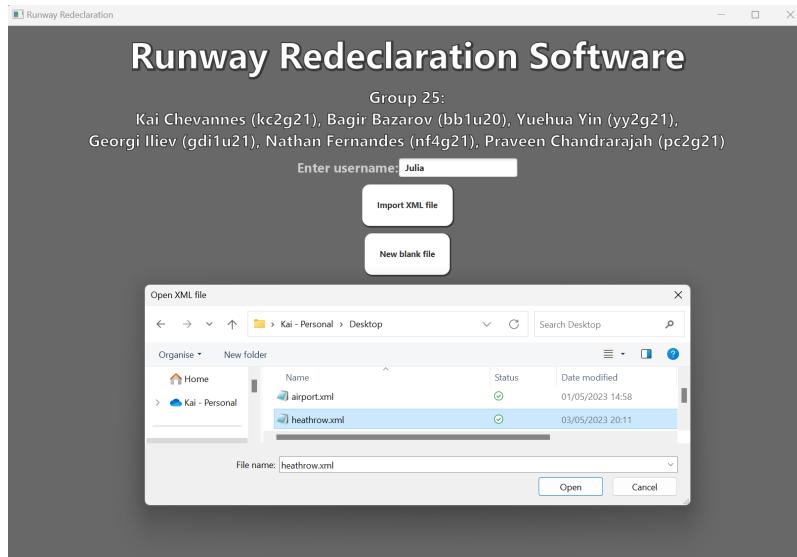


Figure 11: Import existing airport or start a new blank one. Coincide with manual test for User Story ID 10 and 8 - using an example of Heathrow to test if an UK commercial airport was tested

- If starting a blank airport, the system will have a set of predefined obstacles, otherwise there will be obstacles added specifically to the file selected from a previous use of the tool.

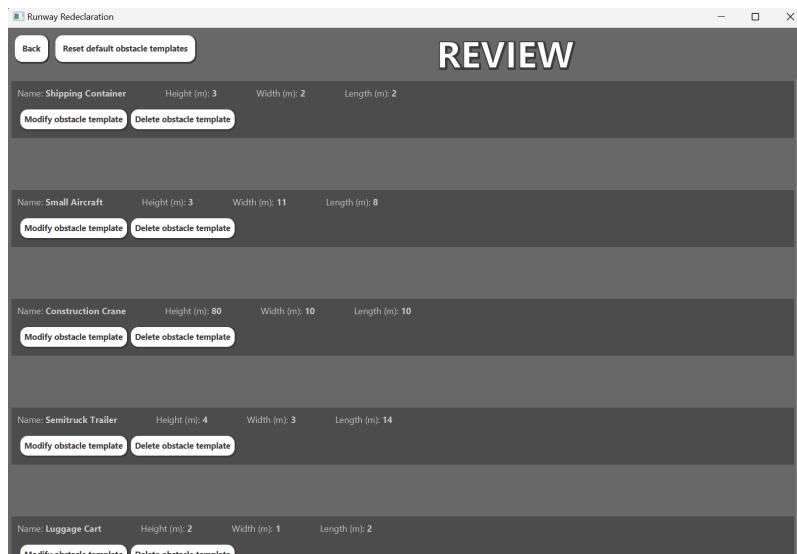


Figure 12: The predefined obstacles when starting a blank file also shows the manual testing for User Story ID 25

- Julia selects the redeclare obstacle view.

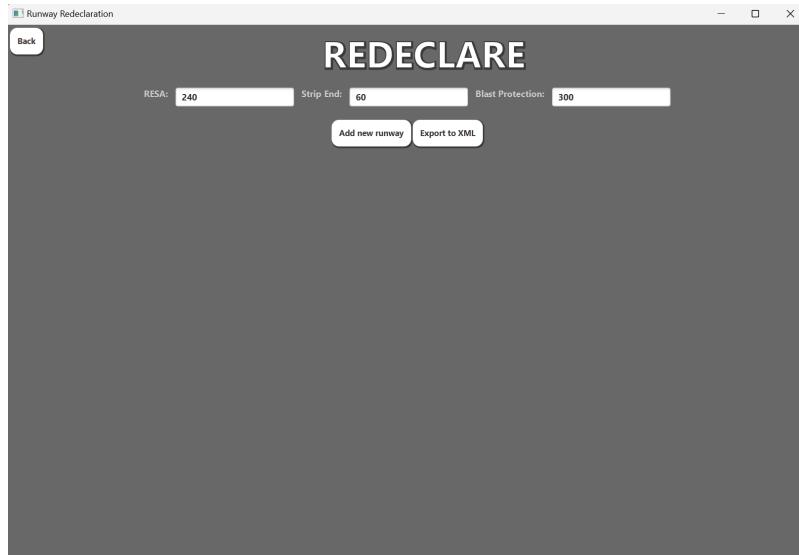


Figure 13: The redeclare obstacle view.

- Julia inputs the airport details.
- Clicks the "Add runway" button

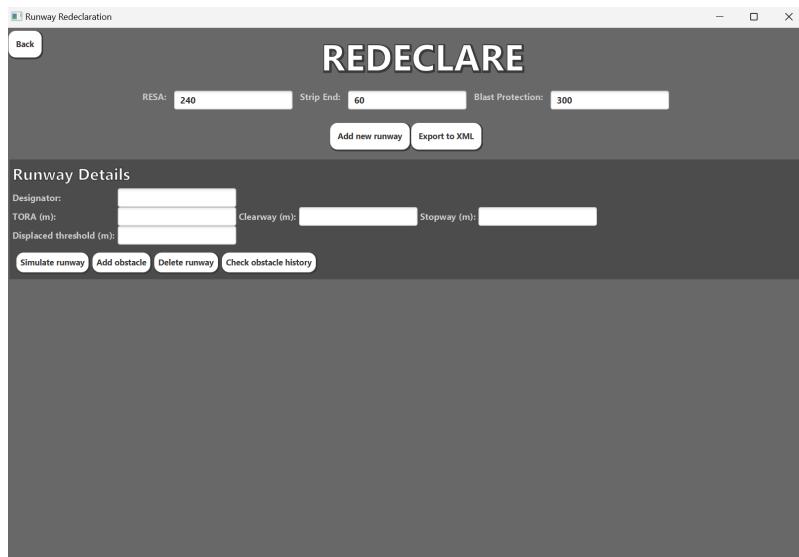


Figure 14: The view of a single runway being added to the software.

- A new runway section shows up, with space for runway details such as TORA, Clearway and stopway.

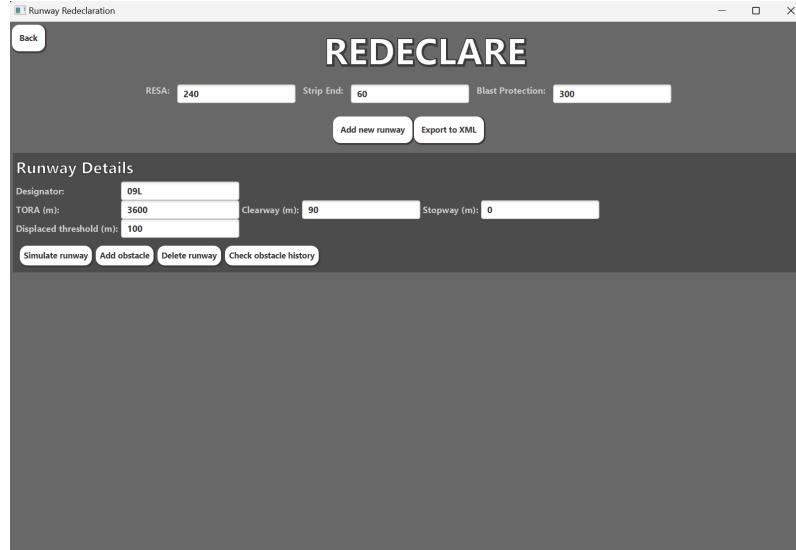


Figure 15: A runway with details added.

- Clicks the "Simulate runway" button
- A runway simulation opens, displaying the runway with a top down view, side on view, with options to rotate and zoom into the visualisations. Underneath the visualisations will be a list of original values and then next to it the recalculated values for the redeclared runway. Finally, underneath that will be a breakdown of calculations, allowing Julia to check her calculations to the system.

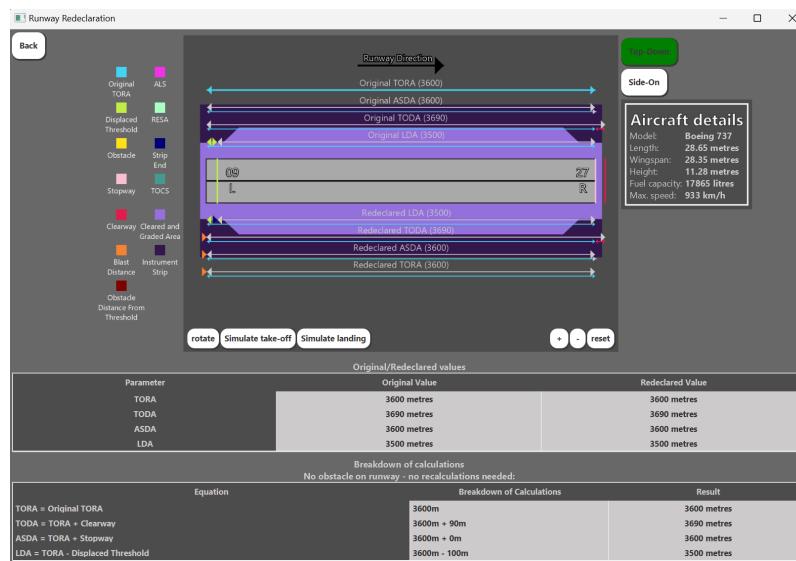


Figure 16: The simulation of the runway. This also evidence showing User stories 2,26 - rotation and zoom in function of the runway

- Julia closes the simulation and clicks the "Add obstacle" button for the runway that was created earlier.



Figure 17: Add an obstacle to the runway. Evidence of User Story 9 of the notification prompt in the top right

- A new drop down menu is shown which allows her to select an obstacle from the obstacles stored in the XML file being worked on.
- Julia selects the "Small Aircraft" obstacle which has a corresponding height.

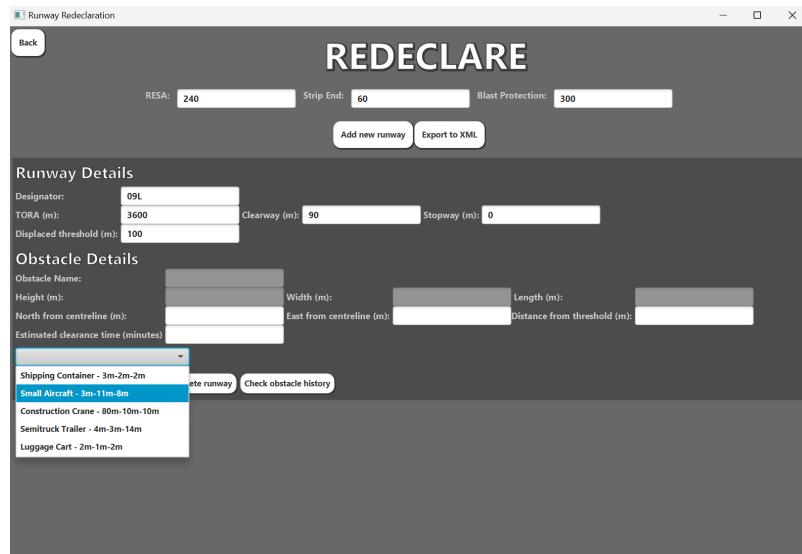


Figure 18: Choose the small aircraft obstacle.

- Julia inputs the remaining data about the obstacle such as distance from the start of the runway.

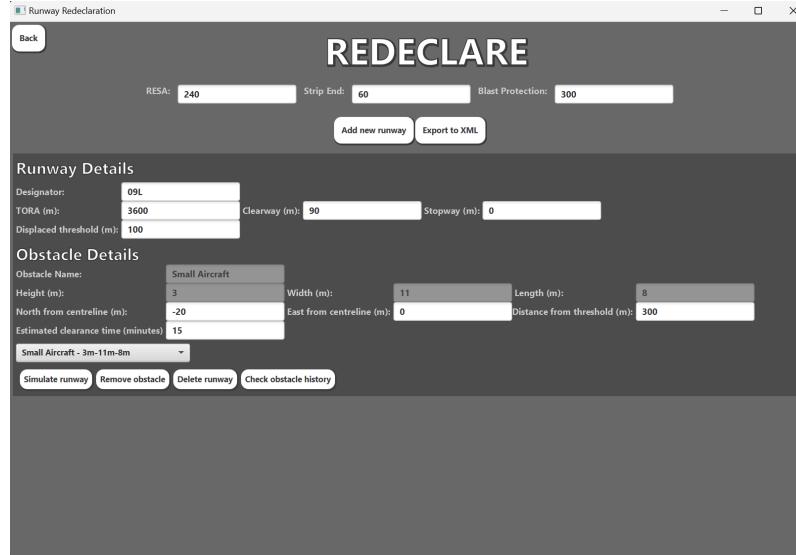


Figure 19: Add extra runway information.

- Julia clicks the "Simulate runway" button and the same window from before is brought up, but this time there is a visualisation of the object on the runway with an associated calculation breakdown.

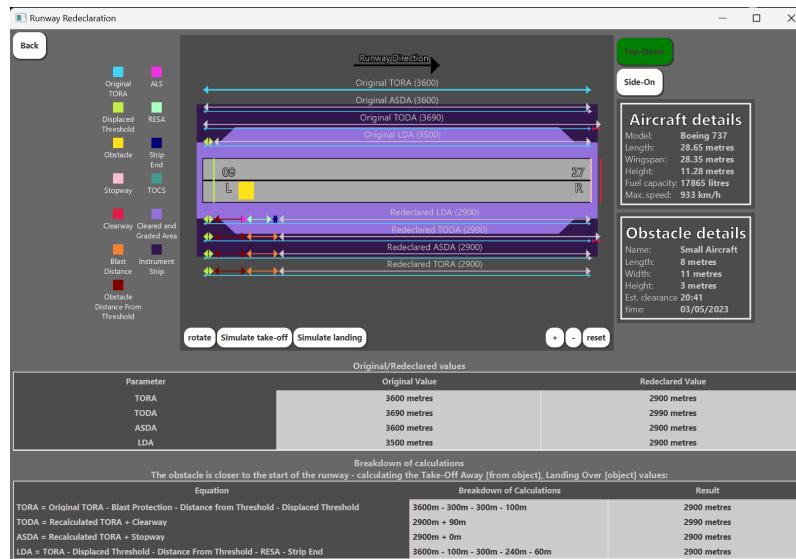


Figure 20: The simulation of the runway with an obstacle on it. This showcase the clear and graded view tested in User Story ID 28 and 13 showing key information about the aircraft and obstacle

- Julia closes the simulation
- Julia clicks the "Add runway" button and adds a new runway as before.

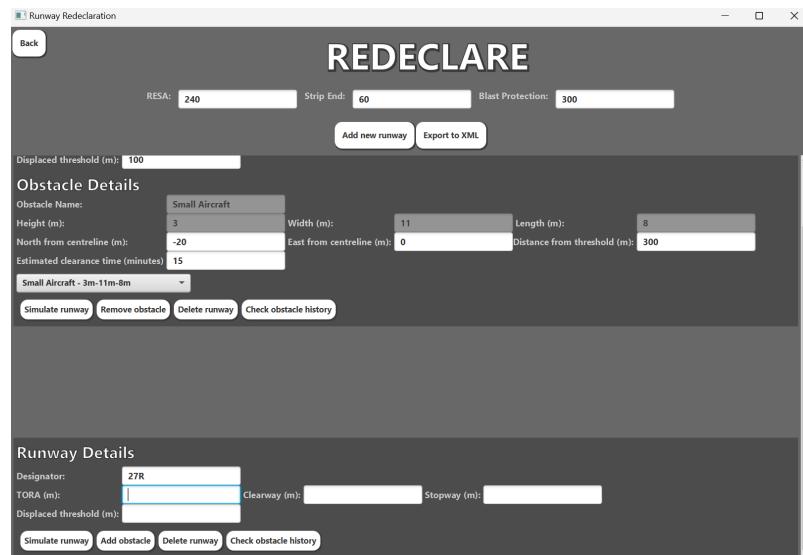


Figure 21: Add another runway.

- Julia clicks the "Export to XML" button which will export all of the runway information to an XML file, this can then be imported the next time that the system is used.

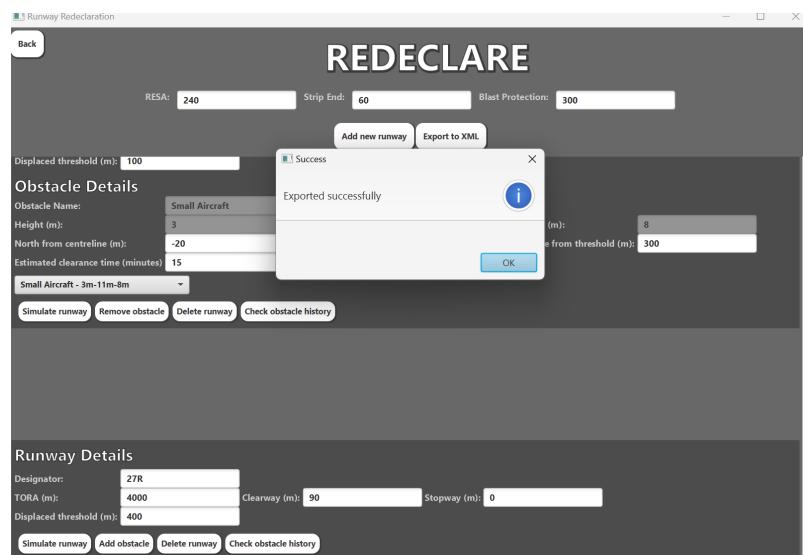


Figure 22: Export the airport with 2 logical runways.

- Julia navigates back to the menu screen by using the escape key or clicking on the back button.

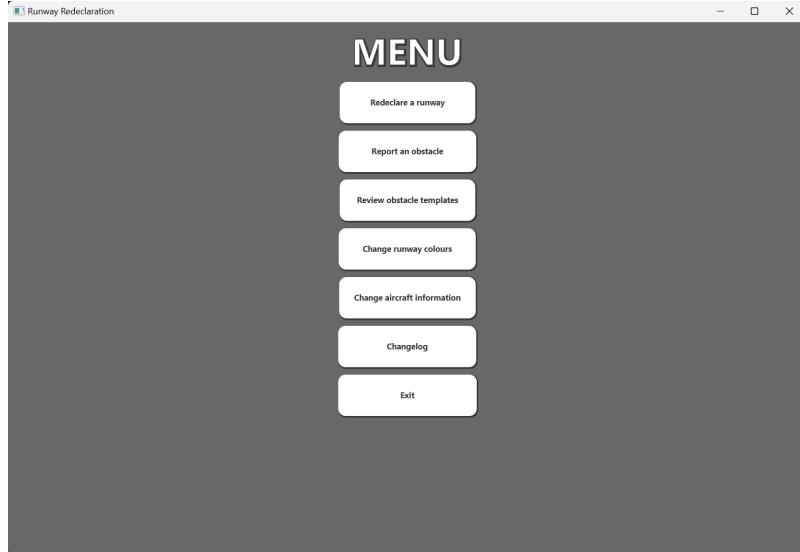


Figure 23: Navigate back to the menu.

- Julia clicks on the "changelog" button
- All of the changes have been logged successfully, allowing her to look back on previous calculations.

CHANGELOG					
Title	Type	Description	Timestamp	Username	
File export	I/O	Details exported to XML: Airport: 240m RESA, 60m strip end, 300m blast protection Runway 09L: TORA = 3600 metres Clearway = 90 metres Stopway = 0 metres Displaced threshold = 100 metres Obstacle name = Small Aircraft Obstacle height = 3 metres Obstacle north distance from centreline = -20 metres Obstacle east distance from centreline = 0 metres Obstacle distance from threshold = 300 metres Runway 27R: TORA = 4000 metres Clearway = 90 metres Stopway = 0 metres Displaced threshold = 400 metres Obstacle name = null Obstacle height = null metres Obstacle north distance from centreline = null metres Obstacle east distance from centreline = null metres Obstacle distance from threshold = null metres	2023.05.03 20.27...	Julia	
Runway redeclared	Calculation	Runway 09L: New TORA = 2900 metres New TODA = 2990 metres New ASDA = 2900 metres New LDA = 2900 metres	2023.05.03 20.26...	Julia	
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 20.24...	Julia	
Runway redeclared	Calculation	Runway 09L: New TORA = 3600 metres New TODA = 3690 metres New ASDA = 3600 metres New LDA = 3500 metres	2023.05.03 20.24...	Julia	
File select	I/O	New blank XML file created	2023.05.03 20.22...	Julia	

Figure 24: The changelog scene with Julia's changes. This shows evidence of User Story ID 17

Runway Maintenance Worker (Josh, 46):

- Josh opens the runway redeclaration tool.
- Josh imports an existing airport XML file or starts a new blank XML file.

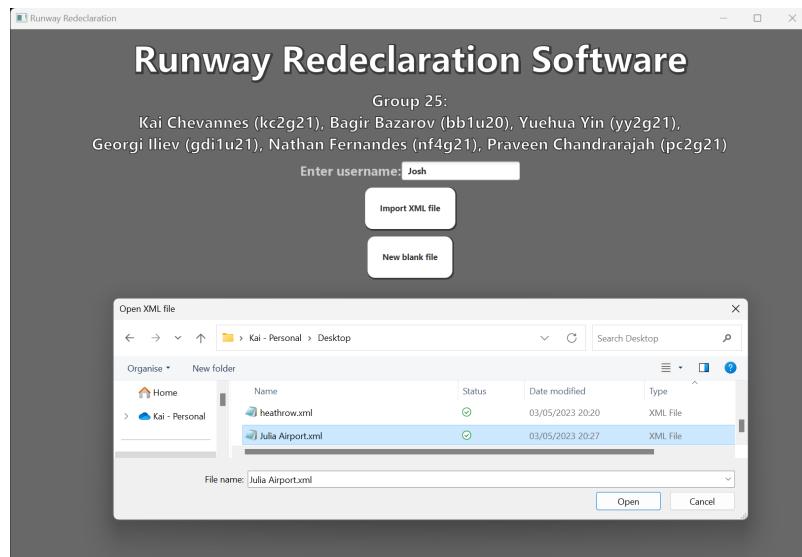


Figure 25: Import an existing airport or start a new blank file.

- Josh selects the report obstacle view.

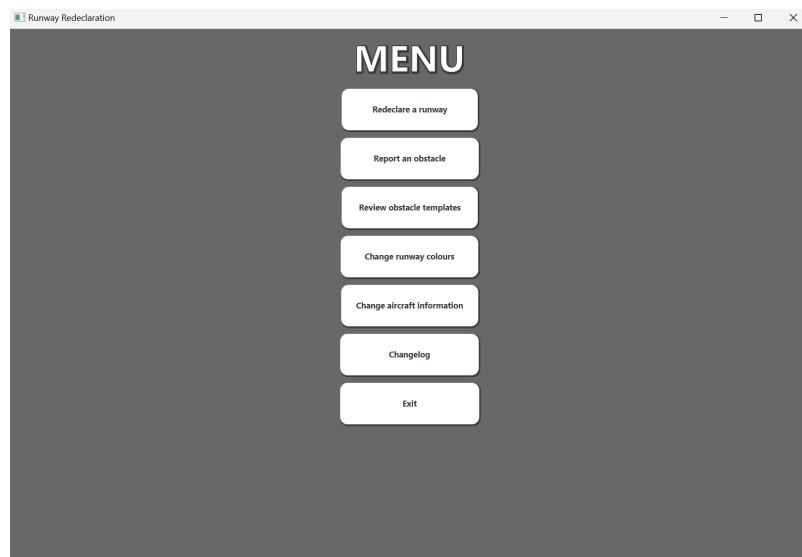


Figure 26: Click the report obstacle button from the menu.

- Click "Report new obstacle".
- Screen to report an obstacle appears with things about the obstacle such as name, width, height, etc.

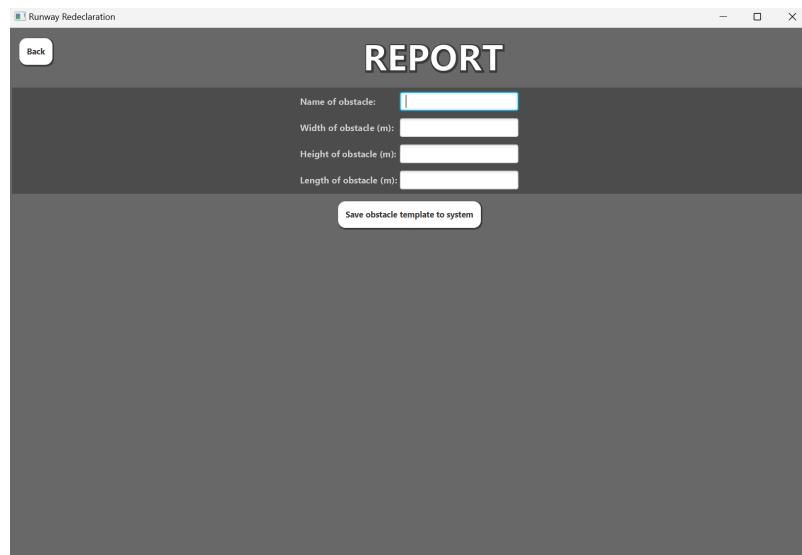


Figure 27: Screen to add obstacle details. Evidence to show User Story ID 6

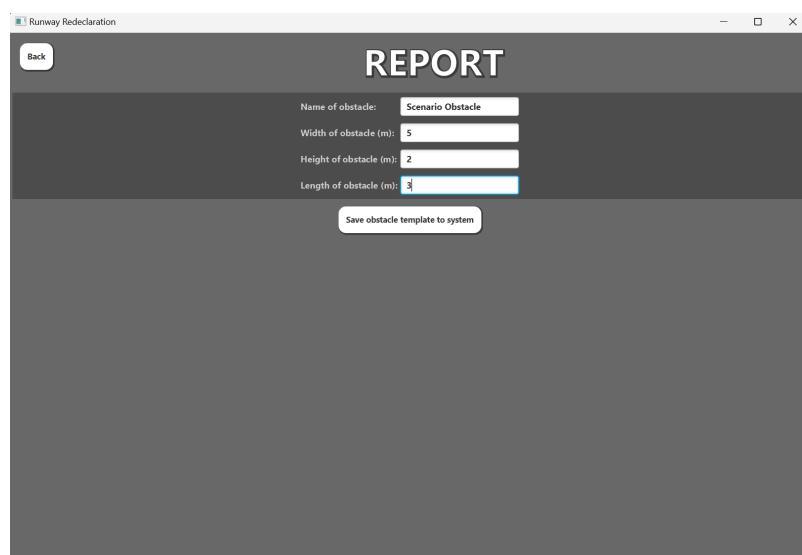


Figure 28: Details added for new obstacle.

- Click "Save obstacle".

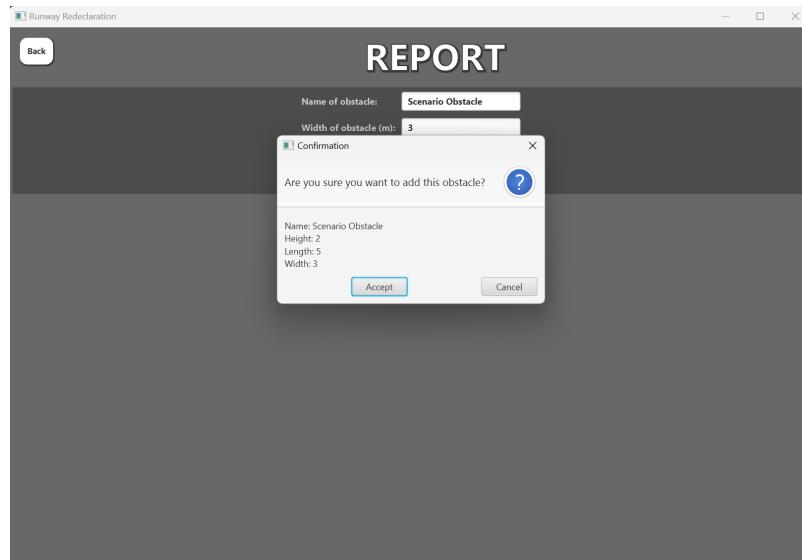


Figure 29: Confirmation menu for the new obstacle.

- Obstacle is saved to the system.

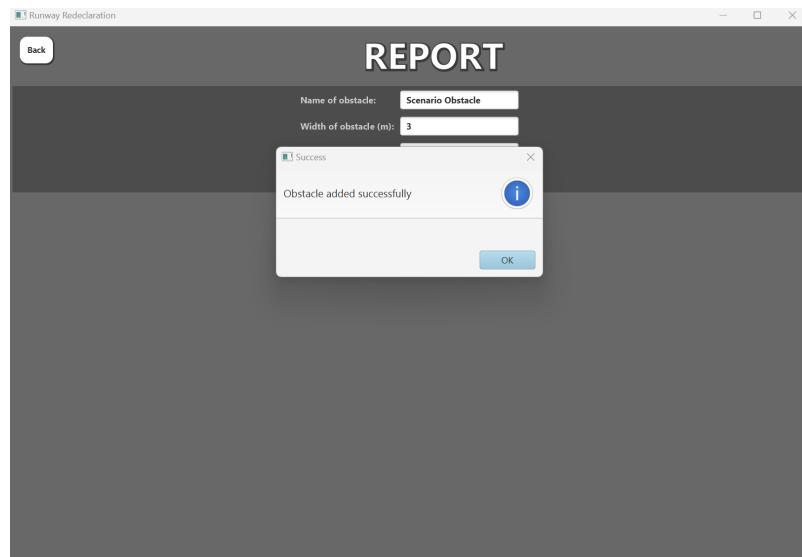


Figure 30: Obstacle saved to the system.

Airport Accident Investigator (Sarah, 55):

- Sarah opens the runway redeclaration tool.
- Sarah opens an existing XML file for an airport she is working on.

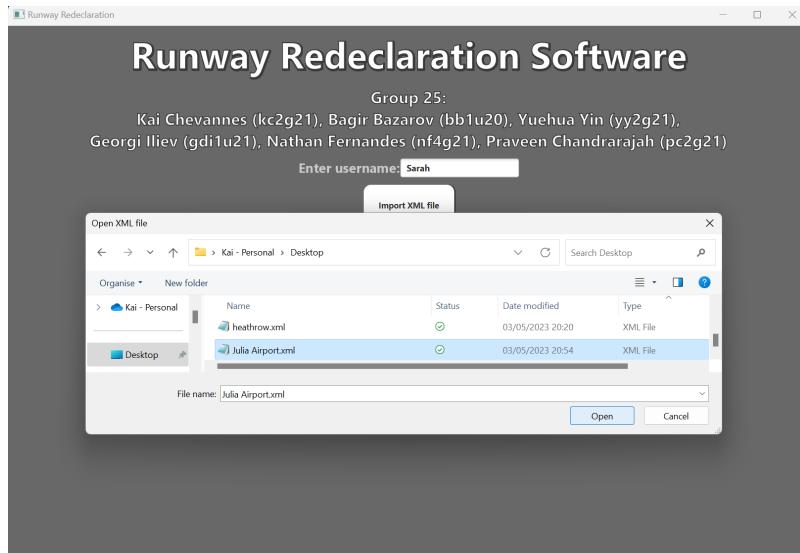


Figure 31: Open an existing XML file, in this case the file Julia exported in the previous scenario test.

- Sarah clicks the "Redeclare" button and then "Simulate" on the runway she is investigating.

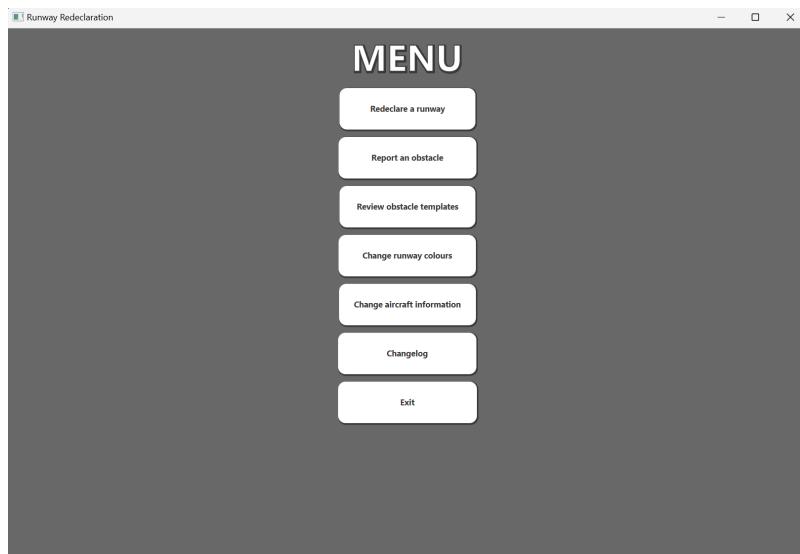


Figure 32: Click on the redeclare button.

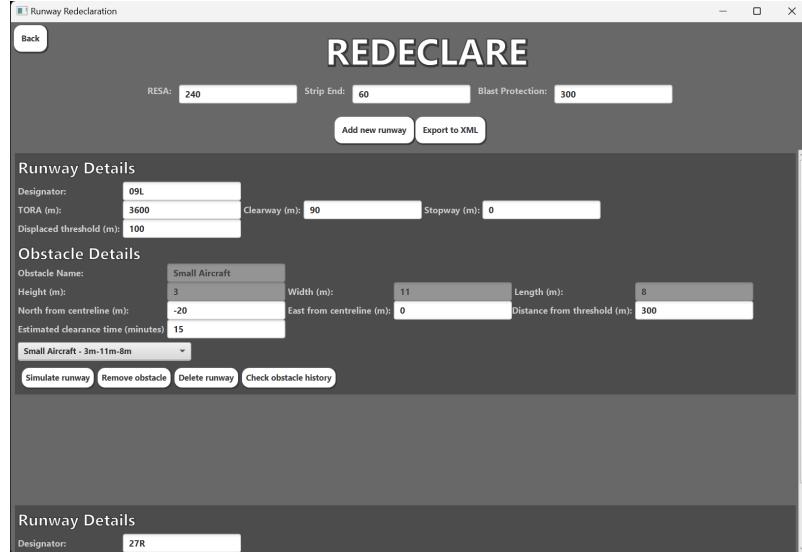


Figure 33: Check which runway needs to be investigated based on the designator.

- Sarah then views the visualisation of the obstacle to understand the layout of a potential incident.

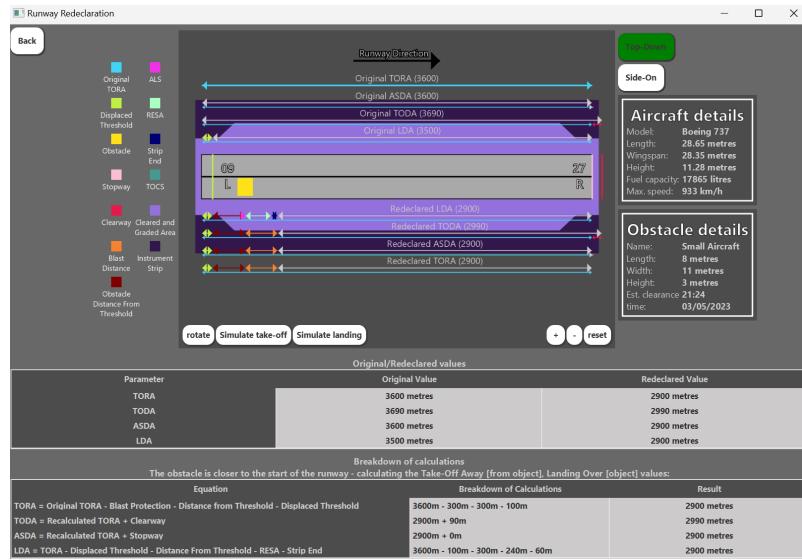


Figure 34: Check the visualisation of the obstacle. Shows breakdown of calculations User story ID 3

- Sarah exits out of the simulation and goes back to the menu using the escape key or clicking on the back button.

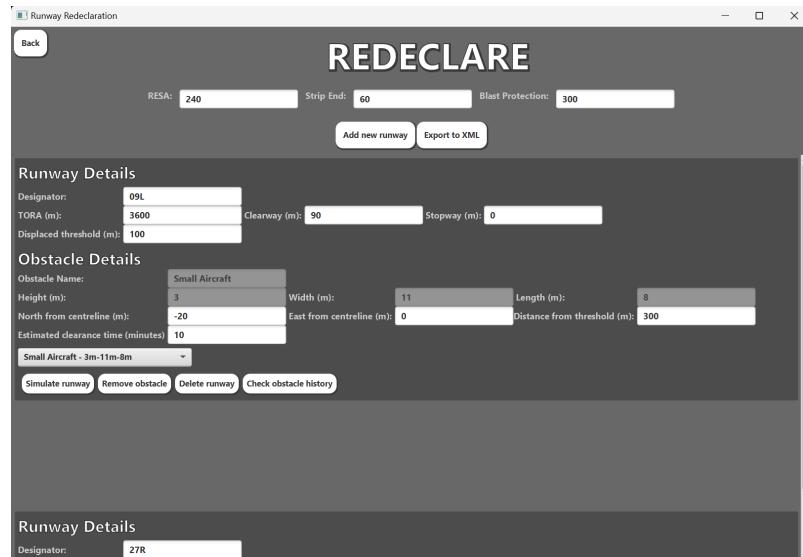


Figure 35: Go back to the redeclare scene first to check the obstacle history local to the runway.

Obstacle history data for runway 09L		
Obstacle Name	Time Added	Time Deleted
Small Aircraft	2023.05.03 20:25:26	2023.05.03 21:13:10
Luggage Cart	2023.05.03 21:13:13	2023.05.03 21:13:14
Scenario Obstacle	2023.05.03 21:13:18	2023.05.03 21:13:19
Small Aircraft	2023.05.03 21:13:21	

Figure 36: The obstacle history of the runway being investigated.

- Sarah clicks the "Changelog" button.
- Sarah can now view a history of obstacles and where they have been to help her investigation.

CHANGELOG					
Title	Type	Description	Timestamp	Username	
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 20:24...	Julia	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 09L	2023.05.03 21:09...	Sarah	Sarah
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 21:09...	Sarah	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 09L	2023.05.03 21:10...	Sarah	Sarah
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 21:10...	Sarah	Sarah
Runway deleted	Runway	Runway 09L deleted	2023.05.03 21:10...	Sarah	Sarah
Obstacle added	Runway	Obstacle added to runway 27R	2023.05.03 21:10...	Sarah	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 27R	2023.05.03 21:11...	Sarah	Sarah
Obstacle added	Runway	Obstacle added to runway 27R	2023.05.03 21:11...	Sarah	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 27R	2023.05.03 21:11...	Sarah	Sarah
Obstacle added	Runway	Obstacle added to runway 27R	2023.05.03 21:11...	Sarah	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 27R	2023.05.03 21:11...	Sarah	Sarah
Obstacle added	Runway	Obstacle added to runway 27R	2023.05.03 21:11...	Sarah	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 27R	2023.05.03 21:11...	Sarah	Sarah
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 21:13...	Sarah	Sarah
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 21:13...	Sarah	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 09L	2023.05.03 21:13...	Sarah	Sarah
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 21:13...	Sarah	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 09L	2023.05.03 21:13...	Sarah	Sarah
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 21:13...	Sarah	Sarah

Figure 37: The history of obstacle changes in the changelog scene.

Pilot (Michael, 56):

- Michael opens the runway redeclaration tool.
- Michael opens an existing XML file for the airport they will be landing at.

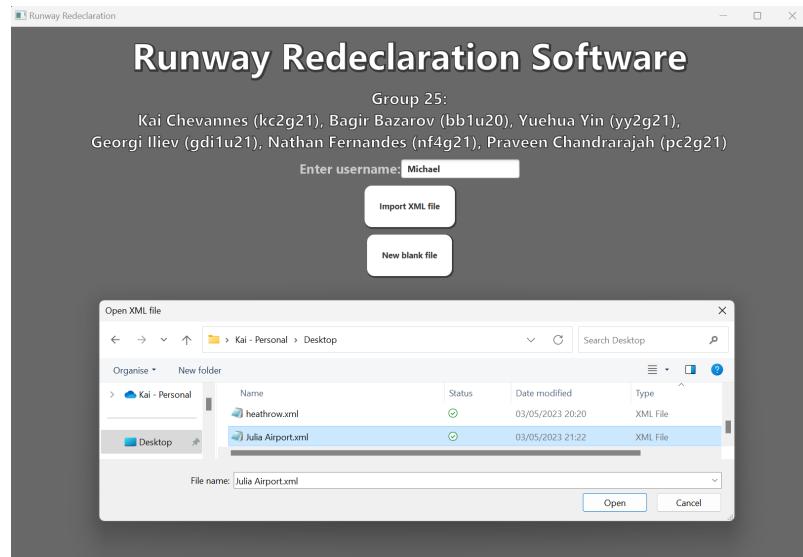


Figure 38: Open an existing file, in this case the file exported by Julia in the earlier scenario test.

- Michael clicks the "Redeclare" button and then "Simulate" on the runway he is going to be landing on.

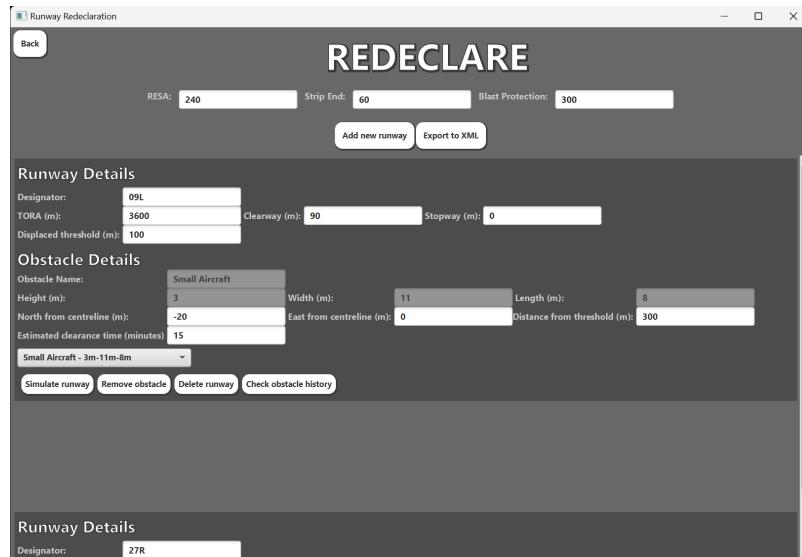


Figure 39: Click the redeclare button.

- Michael can now use the values outputted to safely plan his landing.

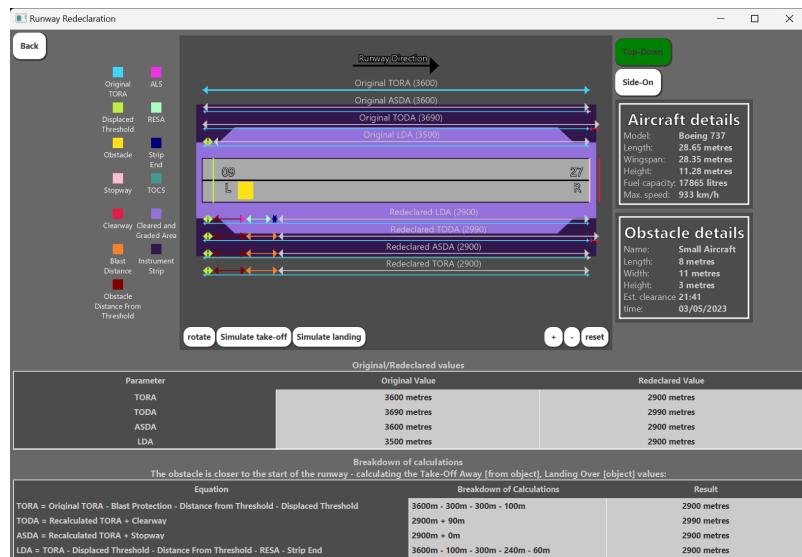


Figure 40: Check the values such as LDA to see how much space is available for landing.

Flight Attendant (Emily, 25):

- Emily opens the runway redeclaration tool.
- Emily opens an existing XML file for the airport they will be landing at.

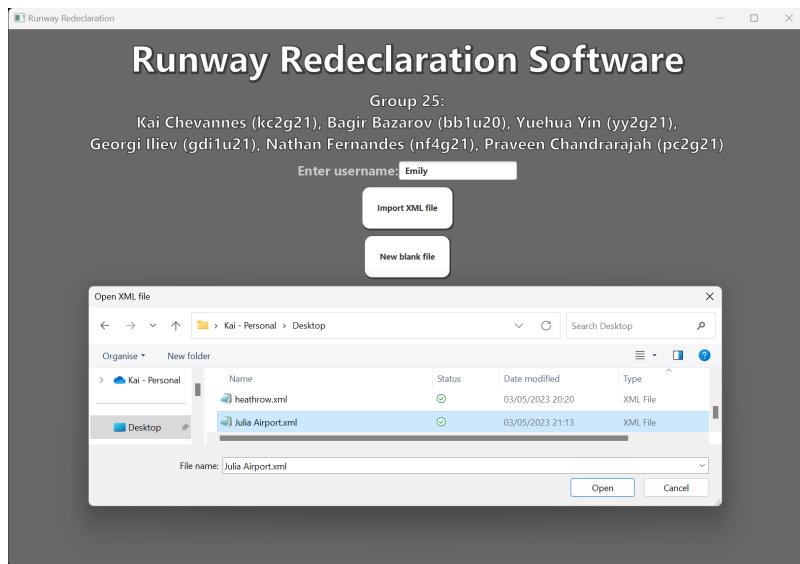


Figure 41: Import an existing runway, in this case the one from the earlier scenario test.

- Emily clicks the "Redeclare" button and then look for the runway they will be landing on.

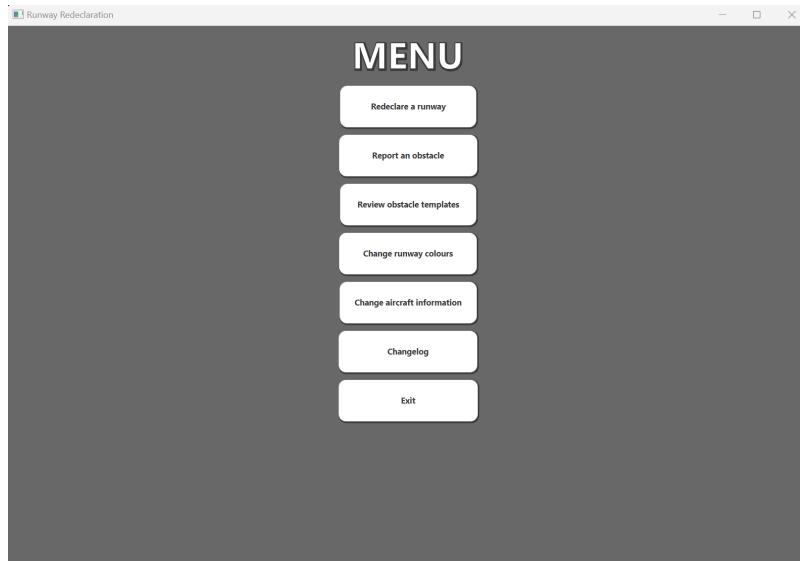


Figure 42: Click the redeclare button.

- Emily can now use the obstacle shown by the system combined to advise passengers about why their landing may be delayed.



Figure 43: Look for runway 09L that they will be landing on, a small aircraft is blocking the runway so this information can be used to advise passengers.

Airport Operations Manager (Robert, 44):

- Robert opens the runway redeclaration tool.
- Robert opens an existing XML airport document or begins a blank one.

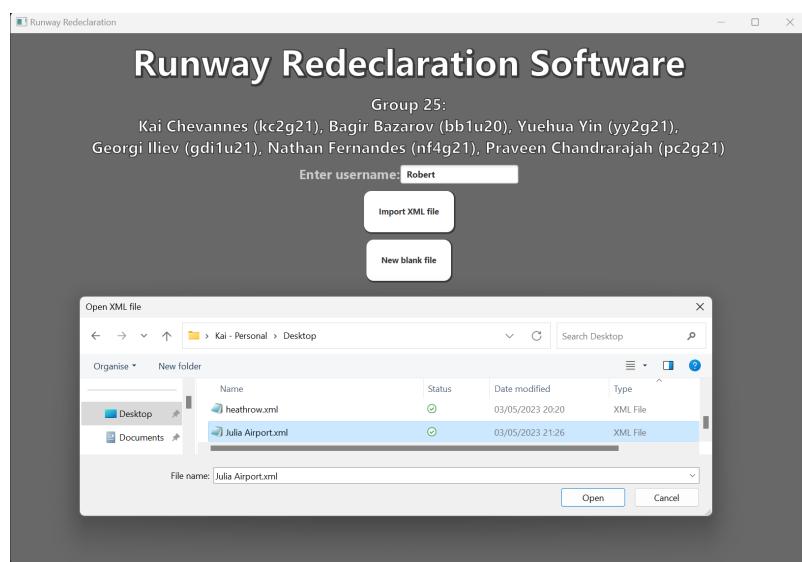


Figure 44: Open existing XML file, in this case the one exported by Julia in the previous scenario test.

- Robert selects "review obstacle" button.

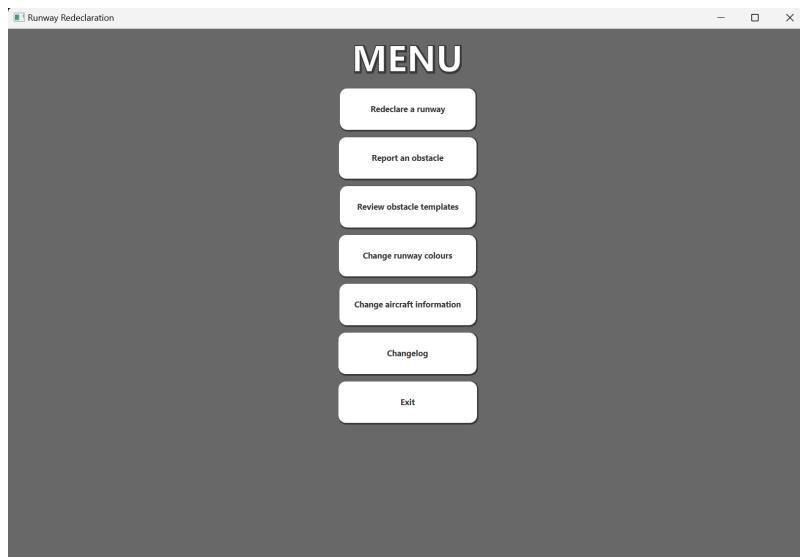


Figure 45: Click the review obstacle templates button.

- For each obstacle, Robert can verify measurements and remove any obstacles that are not appropriate, this obstacle will now be removed from the system.

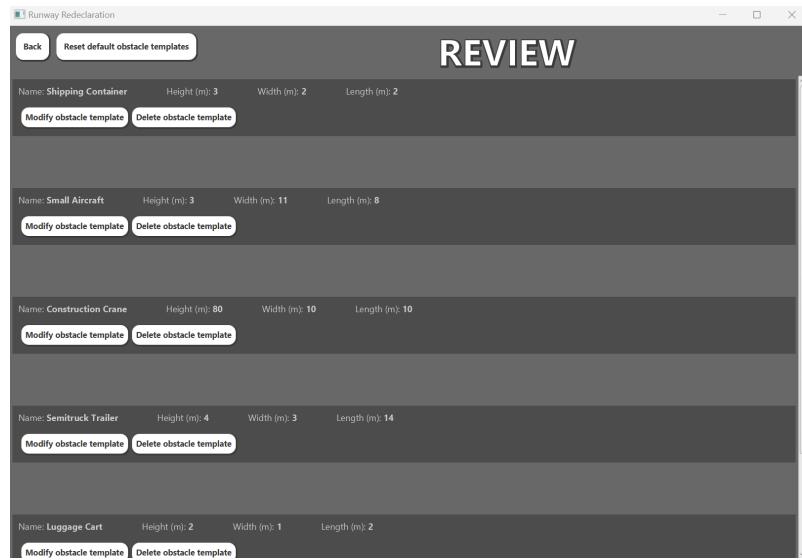


Figure 46: The review scene.

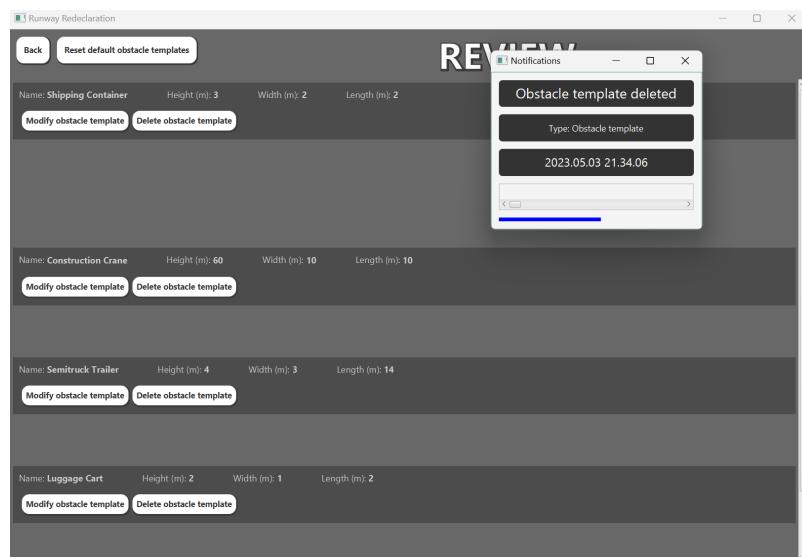


Figure 47: Remove the small aircraft.

- Robert will also have the option to modify an obstacle if there has been a typo for example and a height has been set to 100 metres instead of 10 metres.
- Robert clicks the "Modify obstacle" button
- A pop-up window will come up with fields to change.

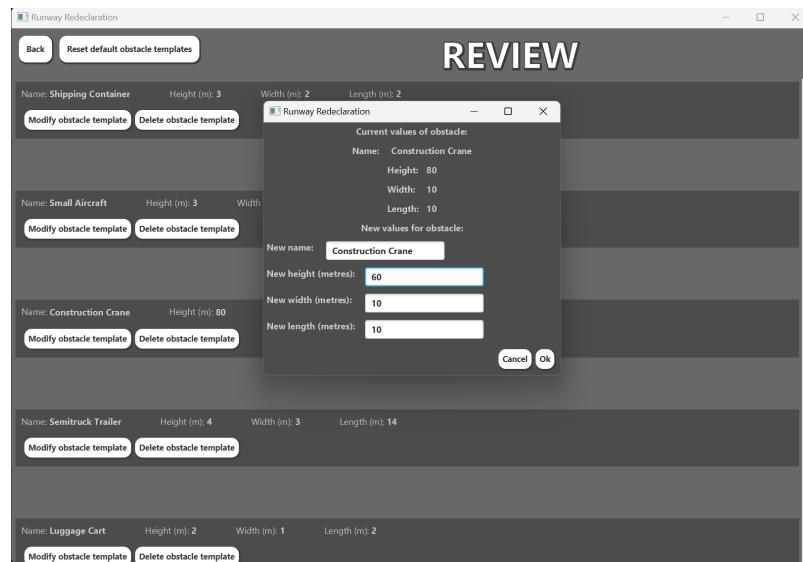


Figure 48: Modify an obstacle.

- Robert changes the values as appropriate and clicks on the "Save" button.

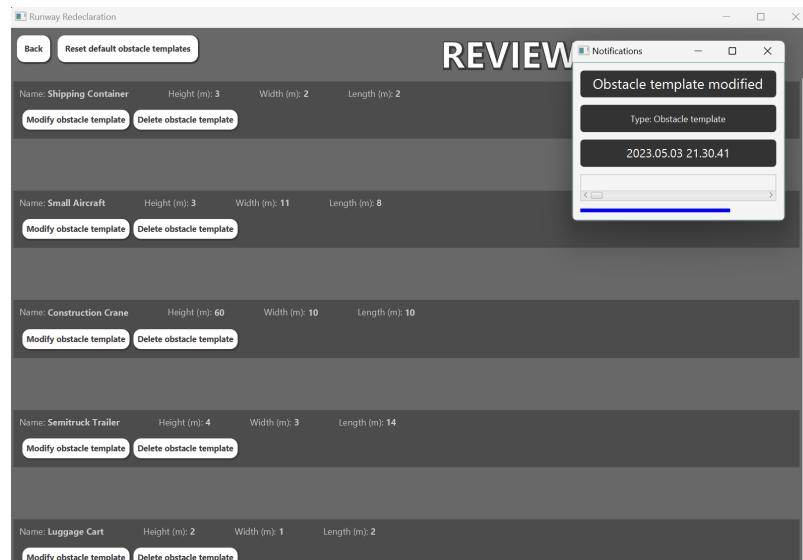


Figure 49: Save the modified obstacle.

- The updated obstacle will now be saved to the XML file, ready for the air traffic controller to use.
- Click the “changelog” button .

Runway Redeclaration

Back Filter changes by type: All I/O Runway Obstacle template Aircraft details Calculation

CHANGELOG

Title	Type	Description	Timestamp	Username
File select	I/O	New blank XML file created	2023.05.03 20:22...	Julia
Runway redeclared	Calculation	Runway 09L New TORA = 3600 metres New TODA = 3690 metres New ASDA = 3600 metres New LDA = 3500 metres	2023.05.03 20:24...	Julia
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 20:24...	Julia
Runway redeclared	Calculation	Runway 09L New TORA = 2900 metres New TODA = 2990 metres New ASDA = 2900 metres New LDA = 2900 metres	2023.05.03 20:26...	Julia
File export	I/O	Details exported to XML: Airport: 240m RESA, 60m strip end, 300m blast protection Runway 09L: TORA = 3600 metres Clearway = 90 metres Stopway = 0 metres Displaced threshold = 100 metres Obstacle name = Small Aircraft Obstacle height = 3 metres Obstacle north distance from centreline = -20 metres Obstacle east distance from centreline = 0 metres Obstacle distance from threshold = 300 metres Runway 27L: TORA = 4000 metres Clearway = 90 metres Stopway = 0 metres Displaced threshold = 400 metres Obstacle name = null Obstacle height = null metres Obstacle north distance from centreline = null metres Obstacle east distance from centreline = null metres Obstacle distance from threshold = null metres	2023.05.03 20:27...	Julia
File select	I/O	Selected existing XML file	2023.05.03 20:47...	Josh
File select	I/O	Selected existing YML file	2023.05.03 20:51	Josh

Figure 50: Changelog scene.

- Robert can now view all previous changes to the system, with options to filter by notification types such as "Obstacle" or "Runway"

Runway Redeclaration

Back Filter changes by type: All I/O Runway Obstacle template Aircraft details Calculation

CHANGELOG

Title	Type	Description	Timestamp	Username
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 20:24...	Julia
Obstacle deleted	Runway	Obstacle deleted from runway 09L	2023.05.03 21:09...	Sarah
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 21:09...	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 09L	2023.05.03 21:10...	Sarah
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 21:10...	Sarah
Runway deleted	Runway	Runway 09L deleted	2023.05.03 21:10...	Sarah
Obstacle added	Runway	Obstacle added to runway 27R	2023.05.03 21:10...	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 27R	2023.05.03 21:11...	Sarah
Obstacle added	Runway	Obstacle added to runway 27R	2023.05.03 21:11...	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 27R	2023.05.03 21:11...	Sarah
Obstacle added	Runway	Obstacle added to runway 27R	2023.05.03 21:11...	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 27R	2023.05.03 21:11...	Sarah
Obstacle added	Runway	Obstacle added to runway 27R	2023.05.03 21:11...	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 09L	2023.05.03 21:13...	Sarah
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 21:13...	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 09L	2023.05.03 21:13...	Sarah
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 21:13...	Sarah
Obstacle deleted	Runway	Obstacle deleted from runway 09L	2023.05.03 21:13...	Sarah
Obstacle added	Runway	Obstacle added to runway 09L	2023.05.03 21:13...	Sarah

Figure 51: Filtered by runway.

Runway Redeclaration

Back Filter changes by type All I/O Runway Obstacle template Aircraft details Calculation

CHANGELOG

Title	Type	Description	Timestamp	Username
Obstacle template added	Obstacle template	Obstacle template for Scenario Obstacle added	2023.05.03 20.52...	Josh
Obstacle template modified	Obstacle template	Obstacle template for Construction Crane modified: New name = Construction Crane New height = 80	2023.05.03 21.30...	Robert
Obstacle template modified	Obstacle template	Obstacle template for Construction Crane modified: New name = Construction Crane New height = 60	2023.05.03 21.30...	Robert
Obstacle template modified	Obstacle template	Obstacle template for Construction Crane modified: New name = Construction Crane New height = 60	2023.05.03 21.30...	Robert

Figure 52: Filtered by obstacle templates.

- This allows him to check that the air traffic controllers are performing their jobs appropriately.

7 Acceptance criteria

Our group created a list of acceptance criteria which was accepted by the customer if the user story was adequate enough to pass the test. In our previous submissions we had used unit testing and the 'TestFX' framework library and it was able to test the code manually. In our process of regression testing we did carry out the testing we did in our previous increments.

For every user story ID there is evidence of testing, these are mentioned on figures above and if not screen shots are present below the table.

User story ID	User story	Criteria	Pass/Fail
1	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.	<ul style="list-style-type: none"> • Calculations should be verified by through appropriate unit tests and tested on paper to verify onscreen calculations are accurate and reliable • The calculations should be displayed clearly and legibly, allowing the air traffic controller to easily read and interpret them • The calculations should be updated in real-time, reflecting any changes in the flight plan or other relevant factors that may affect the calculations 	PASS
2	As an air traffic controller, I want to be able to zoom in on/rotate the simulation so that I can see all the details and relay them to the pilot.	<ul style="list-style-type: none"> • The software should provide the ability to zoom in and out of the simulation view using a standard input device, such as a mouse or touchpad. • The zoom and rotation features should be intuitive and easy to use, with clear instructions or tips provided if necessary • The zoom and rotation features should not cause any distortion or blurring of the simulation view, ensuring that the air traffic controller can clearly see and relay all necessary details to the pilot 	PASS
3	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.	covered in user story 1	PASS
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.	<ul style="list-style-type: none"> • The software should provide the ability to switch between top-down and side-on views of the simulation for a plane taking off/landing using a standard input device, such as a mouse or touchpad • The software should provide the ability to toggle between different levels of zoom in both top-down and side-on views, allowing the air traffic controller to see more or less detail as needed 	PASS
5	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.	<ul style="list-style-type: none"> • The software should provide real-time feedback on the configuration changes, updating the simulation view accordingly to reflect the new runway dimensions • The software should allow the air traffic controller to modify the runway configuration during the simulation, enabling them to adjust to changing conditions or requirements 	PASS
6	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.	<ul style="list-style-type: none"> • The software should allow the airport operations manager to view the location, type, and characteristics of each new obstruction, and compare it with existing data to ensure accuracy and completeness • The software should provide appropriate alerts or notifications to the airport operations manager if any discrepancies or inconsistencies are detected in the new obstruction data 	PASS

7	As an airport operations manager, I want to view a history of calculations so that I can monitor my employees work, ensuring the safety of the airport.	<ul style="list-style-type: none"> The history view should be displayed in a user-friendly format, allowing the airport operations manager to easily navigate and search through the calculations The software should provide appropriate access controls and permissions, ensuring that only authorized users can view the history of calculations 	PASS
8	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.	<ul style="list-style-type: none"> The software should be tested using the parameters of a UK commercial airport such as Gatwick or Heathrow which further suggests evidence that there would be the same level of safety at any commercial airport 	PASS
9	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.	<ul style="list-style-type: none"> The notifications should be displayed in a user-friendly format, enabling the airport operations manager to quickly identify and understand the nature and impact of the action taken The notifications should be displayed in real-time, ensuring that the airport operations manager is promptly informed of any actions taken by their employees. 	PASS
10	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.	<ul style="list-style-type: none"> The software should allow the airport operations manager to select and configure the data fields to be imported or exported, enabling them to customize the process according to their requirements in standard format XML. 	PASS
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.	Mentioned in user story 4	PASS
12	As a pilot, I want to be able to zoom in on the system so that I can see more details of the simulation.	Mentioned in user story 2	PASS
13	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.	<ul style="list-style-type: none"> The flight plan and aircraft information should be displayed clearly and prominently, using appropriate indicators or labels to highlight the key information 	PASS
14	As a runway maintenance worker, I want to be able 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.	Mentioned in user story 6	PASS
15	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.	Mentioned in user story 6	PASS

16	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.	<ul style="list-style-type: none"> The software should provide the ability for the runway maintenance worker to perform recalculations for the standard values used in the system, such as runway length, width, and slope 	PASS
17	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.	<ul style="list-style-type: none"> The software should keep a track of repairs in history and log the amount of time taken for completing them The software history of repairs should be able to be viewed by other members of staff to view repairs and to avoid double repairs and confusion 	PASS
18	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).	<ul style="list-style-type: none"> The position should be based on the direction of the runway, ensuring that the threshold is always on the left side regardless of the direction of the landing approach * • The software should provide appropriate feedback and error handling, alerting the runway maintenance worker if any issues or discrepancies are detected in the position of the threshold 	PASS
19	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.	<ul style="list-style-type: none"> The software should allow alternative color schemes or contrast options to be selected from a user-friendly interface, with clear instructions and prompts provided if necessary. 	PASS
20	As a flight attendant, I want to quickly access the updated runway parameters after an obstruction, so that I can keep the passengers informed about the flight status and avoid stress.	mentioned in user story 8	PASS
21	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.	Mentioned in user story 4	PASS
22	As a flight attendant, I want the runway tool to generate a summary of the calculations for the updated runway parameters, so that I can quickly evaluate the feasibility of continuing the operations and make informed decisions.	Mentioned in user story 1	PASS
23	As a flight attendant, I want to easily access the historical data of previous runway parameter calculations and obstacles so that I can keep track of any recurring issues or trends.	Mentioned in user story 8	PASS

24	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.	Mentioned in user 4	PASS
25	As an accident investigator, I want the program to come with a list of predefined common obstacles, such as different types of vehicles, trees, or traffics cone, that are likely to be encountered in airport environment	<ul style="list-style-type: none"> The software should come with a list of predefined common obstacles, such as different types of vehicles, trees, or traffics cone, that are likely to be encountered in airport environment 	PASS
26	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.	<ul style="list-style-type: none"> The software should allow for an option to be able to rotate the runway based on its compass heading given on the Airport details or a manual tool that allows in the software to rotate the runway 	PASS
27	As an accident investigator, I want to directly provide measurements for new obstacles into the system so that I can provide the air traffic controller with all the information for them to do their job.	Mentioned in user story 6	PASS
28	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.	<ul style="list-style-type: none"> The software should provide the ability for the accident investigator to view the cleared and graded areas around the runway strip, including the approach zones, runway safety areas, and stopways. 	PASS
29	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.	Mentioned in user story 8	PASS

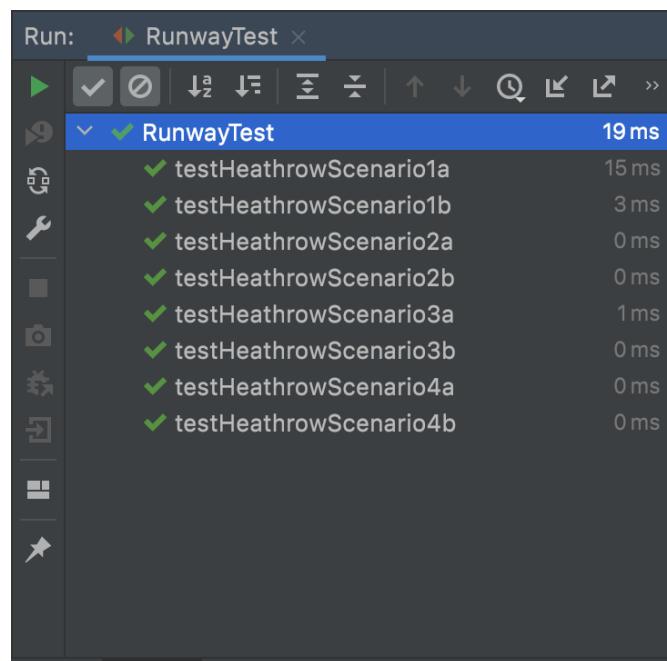


Figure 53: Initial unit test passing of test cases to prove the calculation still work for our specification - User Story ID 1



Figure 54: User Story ID 19 - where colourblind option is given where users can reassign the colours and program was converted to a gray scale format

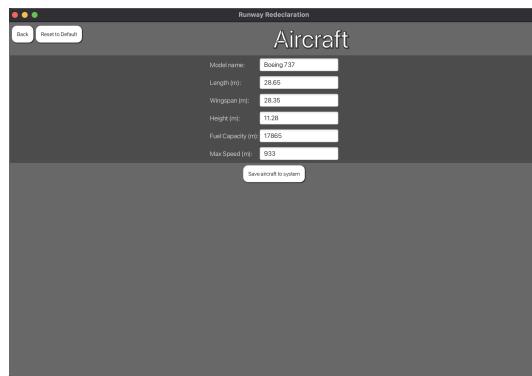


Figure 55: Shows the page for the aircraft modification screen

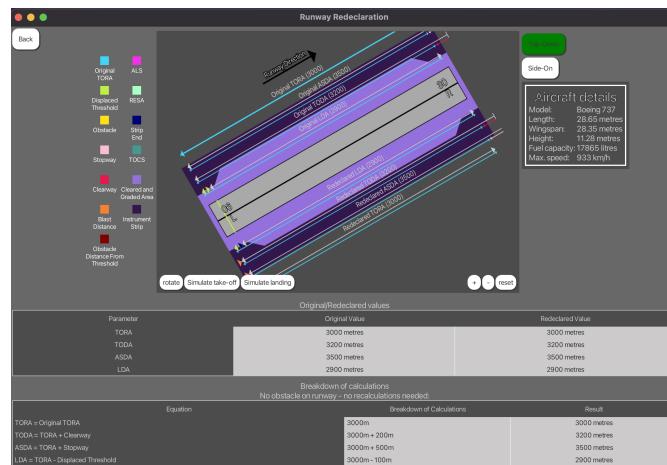


Figure 56: Shows the software rotating the runway when entered with Designator as 06L User Story ID 16

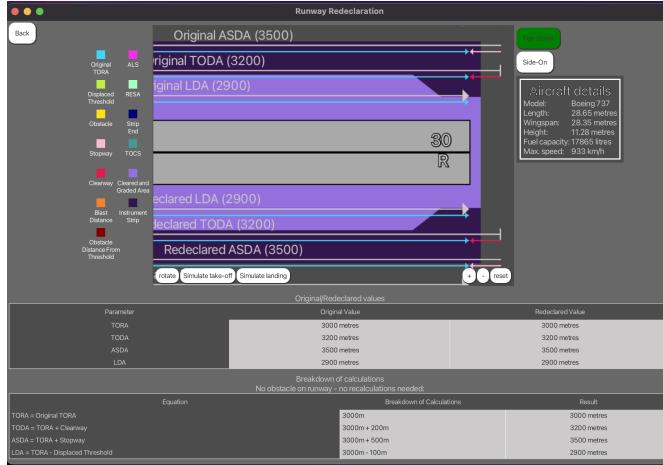


Figure 57: Shows the software showcasing the zoom feature to closely inspect runway

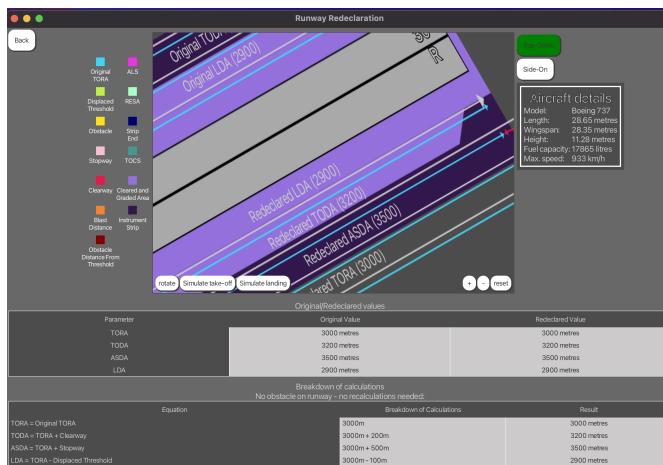


Figure 58: Software showing the rotation and zoom function at the same time

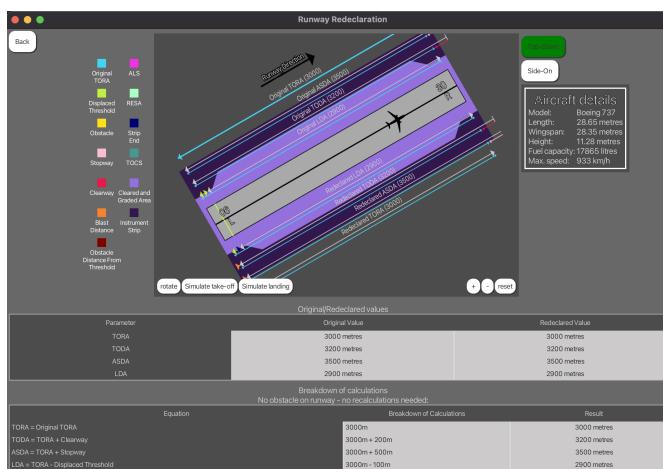


Figure 59: Software has a animation of aircraft landing and taking off, giving an accurate representation to user User Story ID 18

8 Sprint planning

8.1 Sprint 3 Sprint Plan

#	User story	Subtasks	Estimated Size	Allocation	Time spent
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.		4 hours	Main: Yue Backup: Kai Backup: Bagir	3 hours
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.		2 hours	Main: Georgi Backup: Nathan	2 hours
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.		4 hours	Main: Kai Backup: Yue Backup: Praveen	5 hours
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	8 hours	Main: Nathan Backup: Georgi	4 hours
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.		4 hours	Main: Kai Backup: Georgi Backup: Praveen	10 hours
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	2 hours	Main: Praveen Backup: Nathan	2 hours
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	4 hours	Main: Yue Backup: Georgi	3 hours
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.		4 hours	Main: Kai Backup: Yue Backup: Bagir	3 hours
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.		4 hours	Main: Georgi Backup: Praveen	4 hours

8.2 Sprint 3 Burndown Chart

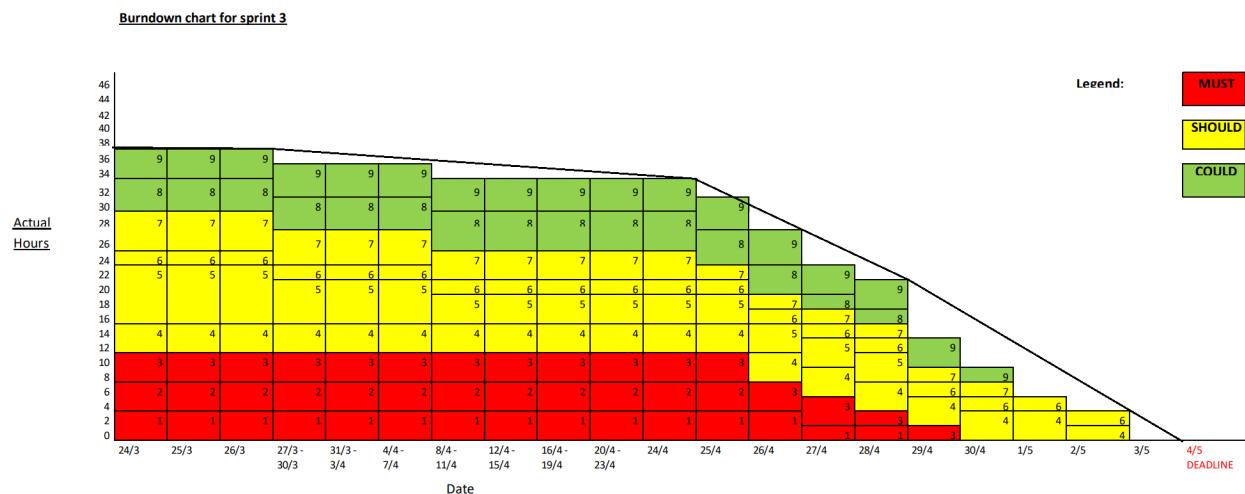


Figure 60:

Burndown chart showing the actual hours per user story left to implement against the date for the second sprint. Each number on the graph represents a sprint ID from the sprint plan. You may have to zoom in to see the graph clearly.