

# SEPR Assessment 3 Test Plan - Team BHD

## Approaches used

Before we began to make large changes to the game, we tested it using the unit tests written for it and by validating the game against the requirements which we had devised for our own implementation. This ensured that we were able to check for any pre-existing bugs, more easily see which features of the game were already implemented and start to gather ideas to improve some aspects.

In order to test our own changes to the game, we wrote unit tests to check that the edited modules still worked and that the desired changes had been implemented. We also used some of the tests written by the team who started developing the game to ensure that the changes which we made did not affect the original functionality. Finally, we also did acceptance tests with our client to ensure that he was happy with the changes made.

Apart from the requirements validation, manual requirements testing and acceptance testing, all of the tests done were white-box tests. We used the waterfall development model for our testing, where we made additional changes to the model as needed after each round of testing. The main phases of testing were the requirements validation and pre-extension unit testing before implementation, the regression testing, new unit tests and requirements testing after the main implementation phase and finally two rounds of acceptance testing with some unit testing in between them.

## Testing Responsibilities

- Requirements validation - Radostin Nanov and Katie Onyett
- Pre-extension unit testing - Radostin Nanov
- Regression testing - changes made by Radostin Nanov and tests executed by Tim Waterson
- New unit tests - written by Tim Waterson and Radostin Nanov and executed by Tim Waterson
- Manual requirements tests - written by Katie Onyett and executed by Chris Harrison
- Acceptance tests - written by Valentin Boyadzhiev

## Requirements validation

To test our original requirements for the game against the one we were given, we play-tested the game and went through the requirements checking whether they had been implemented or not, making additional notes if necessary. We checked the system requirements rather than the user requirements because they were more specific, and included the two additional requirements from the second assessment. However, we also reviewed whether the non-functional requirements were implemented so that we could gain more ideas about additional

features which could be implemented.

The original requirements are listed in the abstract, requirements and conceptual proposal document from the first assessment [3], while the two additional requirements are listed in the architecture and design report from the second assessment [4].

Requirement	Implemented?	Notes
SR1 - Main menu	Yes	
SR2 - help screen	Yes	Through user manual; controls and difficulty selection screen
SR3 - "start" button	Yes	Takes you to difficulty selection
SR4 - generate airspace	Yes	
SR5 - display airspace	Yes	
SR6 - create flights	Yes	
SR7 - GUI, including score and a timer	Partially	Score to be implemented in Assessment 3 by our team
SR8 - varied flight characteristics	Yes	Only speed varies so far
SR9 - display score	No	To be implemented
SR10 - save score	No	To be implemented
SR11 - upload score to master repository	No	Might implement, depending on time constraints
SR12 - monitor separation rules	Yes	
SR13 - generate and remove flights via entry and exit points	Yes	Might make display of violation of separation rules more prominent
SR14 - preset flight plan	Yes	
SR15 - alter flight plan	Yes	
SR16 - change course	Yes	
SR17 - change altitude	Yes	
SR18 - land	No	To be implemented
SR19 - take off	No	To be implemented

SR20 - turn left/right	Yes	
SR21 - update GUI regularly	Yes	Smooth movement of flights across the screen
SR22 - have waypoints	Yes	Entry/exit waypoints blend with the background slightly
SR23 - set flights on crash course occasionally	Yes	Due to randomness of flight generation, not on intent
SR24 - simulate bad weather	No	Might be implemented, depending on time constraints.
SR25 - simulate equipment failures	No	Might be implemented, depending on time constraints.
SR26 - quit button	Yes	Within the pause menu
SR27 - progressively increase difficulty	Yes	With time, flights start coming in quicker; However, this is not immediately obvious.
SR28 - pause/resume	Yes	Can be made more obvious for the user
SR29 (Additional requirement 1) - highlight next waypoint on flight plan	Yes	Done via “plan” mode
SR30 (Additional requirement 2) - fuel gauge and associated game over state	No	Might be implemented, depending on time constraints
NFR efficiency	Yes	Beside a slightly long loading time, game appears to run smoothly
NFR documentation	Yes	Game documentation is extensive
NFR testability	Yes	Unit tests are numerous and easy to run
NFR stability	Yes	Game runs on all machines it was tested on
NFR reliability	Yes	
NFR maintainability	N/A	Will be determined over the course of this assessment
NFR extensibility	N/A	Will be determined over the course of this assessment

NFR accessibility	No	Might be implemented, depending on time constraints
NFR open source	Yes	Code is available freely on Bitbucket
NFR time-to-market	N/A	Fixed deadline
NFR immersivity	Can be tested	Requires an extensive test process with random playtesters - likely to take too much time

## Unit tests before changes

Before we began to make changes to the software we received, we ran the unit tests designed for that software in order to ensure that the software was working correctly without any obvious bugs. This also allowed us to see which areas the received tests tested and which areas they did not.

The original unit tests can be found in the “Unit testing evidence” section of the test plan report submitted by team WAW, who developed the first version of the software [1], while the results report from the running of the unit tests before changes can be found in old\_tests\_out.txt in the testing folder.

## Requirements testing (manual)

The requirements tests in the table below were written in order to test the requirements which we wrote for the extension of the game through a black-box approach (with a more grey-box testing approach being taken by the unit tests). More details of these requirements can be found in the extension report [2].

test	action taken	expected result	actual result	requirement tested
1	A flight in the airspace tries to land at the airport at altitude 2000 and speed 75 mph - no obstructions to landing	error or failure since plane is too far away to land	No response from Land button, plane too high to land	ER1
2	A flight in the airspace tries to land at the airport at altitude 1000 and speed 500 mph - no obstructions to landing	error or failure since plane is travelling too fast to land	No response from Land button, plane travelling too fast to land	ER1
3	A flight in the airspace	error or failure since	No response from Land	ER1

	tries to land at the airport at altitude 2000 and speed 500 mph - no obstructions to landing	plane is too far away and travelling too fast to land	button, plane travelling too fast and too high to land.	
4	A flight in the airspace tries to land at the airport at altitude 1000 and speed 75 mph - no obstructions to landing	flight lands successfully and is removed from the airspace	flight lands successfully and is removed from the airspace	ER1
5	A flight attempts to take off from the airport with no obstructions to it doing so	Flight takes off successfully and enters the airspace	Flight takes off successfully and enters the airspace	ER2
6	Play the game	there is at least one airport in the airspace which can be seen and interacted with	there is at least one airport in the airspace which can be seen and interacted with	ER3
7	Attempt to land a plane while another is taking off	error or failure due to obstruction to landing i.e. the other plane	Plane will not land due to another taking off	ER4
8	Attempt to make a plane take off while another is landing	error or failure due to obstruction to takeoff i.e. the other plane	plane crashes due to separation distances	ER4
9	flight enters the airspace via an entry point and attempts to land at an airport	flight lands successfully	flight lands successfully	ER5
10	flight takes off from an airport and attempts to exit the airspace via an exit point	flight leaves airspace successfully	flight leaves airspace successfully	ER5
11	Play the game (screenshot can be seen in appendix A)	the current score of the game is visible to the player	the current score of the game is visible	ER6
12	make a flight pass through one of the	score is incremented by 100	score is incremented by 100 points	ER6

	waypoints on its flight plan	points		
13	make a flight land or exit without passing through all of its waypoints	score is decremented by 200 points	score is decremented by 200 points	ER6
14	finish playing the game	score is added (and can be seen) on the high scores list		ER7
15	Click “High scores” button on the menu	the user can see the list of high scores		ER8
16	view high scores list, play the game and then view the high scores list again	new score from game played has been added to the high scores list		ER7 and ER8
17	Play the game (screenshot can be seen in appendix A)	at least 10 flights are in the airspace at any one time	at least 10 flights are in the airspace at any one time	ER9

Tests 14-16 could not be successfully carried out since the functionality of a high scores list had not been implemented. This was mainly due to time constraints but also because it was not a priority to implement as opposed to features such as the functionality of controls and the score as used in the actual game.

## Regression tests and New Unit tests

After making changes to the software (specified in the extension report [2]), we re-ran the unit tests which came with the original version of the software [1] to check that the original functionality of the code was not affected by the alterations made. We had to make some changes to the unit tests due to the changes in the code requiring some functions to have additional parameters and suchlike.

However, a meaningful change was made to the updateFlightPlanTest() method in order to verify a new requirement. The test now also checks to see if passing a waypoint increments the score by 100, as well as its previous checks.

In order to test the new functionality implemented, several new unit tests for the game were written in the same java files as the old unit tests. These included:

- 2 new tests for landing (in Flight\_Tests.java)
  - landTest1() - checks that a flight which is not at the airport cannot land
  - landTest2() - checks that a flight which is at the airport, at a valid speed, and velocity, can land
- 2 tests for taking off (in Flight\_Tests.java)
  - takeofftest1() - checks that a flight can take off properly, accelerating and climbing in the process
  - takeofftest2() - checks that an already taken-off flight cannot use the take-off method again
- 5 tests for update velocity method (in Flight\_Tests.java)
  - updateVelocityTest1() and updateVelocityTest2() check for speeding up
  - updateVelocityTest3() and updateVelocityTest4 check for slowing down
  - updateVelocityTest5() checks that a plane stays at its target velocity
- newAirportTest() - check if an airport is drawn at valid coordinates (in Airspace\_Tests.java)
- 2 tests to check remove specific flight function (in Airspace\_Tests.java)
  - removeSpecificTest1() - check for decrement of score if flight still has waypoints when terminated
  - removeSpecificTest2() - check for increment of score if flight has no waypoints left when terminated

The unit tests (both the altered tests and the completely new tests) can be found in the java files Airspace\_Tests, Flight\_Tests, FlightPlan\_Tests and SeparationRules\_Tests, which are all located inside the code folder in src/unitTests. The resulting reports from running these tests can be found in the documents Airpace Tests out, Flight Tests out, FlightPlan Tests out and Separation Tests out, which correspond to the java files containing the unit tests. These reports can be found in appendix B.

## Acceptance testing

Once all of the unit testing and requirements testing was completed to our satisfaction, we had our customer do some acceptance tests upon the game to make sure that he was happy with it. The acceptance tests were partially based on the acceptance tests for the original version of the game [1] but additional tests were also added for the new functionality of the game. The tests are mainly scenario-based, with one scenario often testing several different requirements at a time, in order to avoid unnecessary repeated testing of the same feature.

We had an initial meeting for acceptance testing with the customer, though this resulted in several changes which needed to be made to the software (additional details can be found in the extension report [2]). The main change was making the area in which a plane could land more visible to the user. Therefore we decided to revise the acceptance tests and software (and re-test the software) before having another acceptance testing meeting, where the customer approved of the product.

A list of the final acceptance tests, and the responses of the customer to them, are listed in appendix C.

## Untested areas

Since we did not make any major changes to the menu system, we did not run any unit tests on it. However, it was user-tested while the other requirements were being manually tested so we can be reasonably sure that it works as it is supposed to.

## Sources

- [1] Team WAW, “Test Plan”, Department of Computer Science, University of York, Jan. 2014
- [2] Team BHD, “Extension Report”, Department of Computer Science, University of York, Feb. 2014
- [3] Team BHD, “SEPR assessment 1 Abstract, Requirements and Conceptual Proposal”, Department of Computer Science, University of York, Nov. 2013
- [4] Team BHD, “Test Plan Report”, Department of Computer Science, University of York, Jan. 2014

## Appendix A - screenshot evidence for manual requirements tests

Manual Requirement test 11: checking that a score can be seen by the user



Manual Requirement test 17: checking that there can be 10 planes in the airspace



## Appendix B - unitTests results

### Airspace tests output:

Point BHD set:(572.0,197.0).

Airport BHD set:(572.0,197.0).

Point A set:(350.0,150.0).

Waypoint A set:(350.0,150.0).

Point B set:(400.0,470.0).

Waypoint B set:(400.0,470.0).

Point C set:(700.0,60.0).

Waypoint C set:(700.0,60.0).

Point D set:(800.0,320.0).

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Point E set:(600.0,418.0).

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Point F set:(500.0,220.0).  
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Point G set:(950.0,188.0).  
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Point H set:(1050.0,272.0).  
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Point Airport set:(572.0,197.0).  
Airport Airport set:(572.0,197.0).  
Point TEST set:(150.0,500.0).  
ExitPoint TEST set:(150.0,500.0).  
Point BHD set:(572.0,197.0).  
Airport BHD set:(572.0,197.0).  
Point A set:(350.0,150.0).  
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Point 3 set:(1200.0,300.0).  
ExitPoint 3 set:(1200.0,300.0).  
Point Airport set:(572.0,197.0).  
Airport Airport set:(572.0,197.0).  
Point TEST set:(151.0,500.0).  
Waypoint TEST set:(151.0,500.0).

## **Separation Rules tests output**

Point Airport set:(572.0,197.0).  
Airport Airport set:(572.0,197.0).  
Point A set:(350.0,150.0).  
Waypoint A set:(350.0,150.0).  
Point B set:(400.0,470.0).  
Waypoint B set:(400.0,470.0).  
Point C set:(700.0,60.0).  
Waypoint C set:(700.0,60.0).  
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X: 1.0 Y: 1.0 Flight Number: 0X: 1.0 Y: 1.0 Flight Number: 0

### **Flight tests output**

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### **Flight plan tests output**

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## Appendix C - Acceptance tests and results