## **DP2 – Testing Report**

**Group:** C3.027  
**Repository:** <https://github.com/DP2-C1-027/AirNav-Logistics-C3>

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**Table of Contents**

1. Executive Summary
2. Revision Table
3. Introduction
4. Contents
5. Conclusions
6. Bibliography

## **Executive Summary**

This report provides an overview of the testing phase conducted to assess the functionalities developed by Student 3. The objective of the testing process was to ensure that the implemented features meet the defined quality standards in terms of functionality and performance.

Functional testing confirmed that the developed requirements generally behave as expected, fulfilling the specified criteria. Performance testing was also conducted to evaluate the system’s efficiency under different load conditions. The results indicate that the software performs within acceptable limits, with some areas identified for potential optimization.

Overall, the tests demonstrate that the implemented functionalities are stable and meet the project’s requirements, although minor improvements could further enhance performance and maintainability.

## **Revision Table**

|  |  |  |
| --- | --- | --- |
| **Revision Number** | **Date** | **Description** |
| 1.0 | 02/17/2025 | Initial version of the document |
| 2.0 | 07/04/2025 | Adapted to C2. |
| 3.0 | 10/13/2025 | Adapted to C3. |

## **Introduction**

The purpose of this document is to analyze and evaluate the operation and performance of the requirements developed by Student 3. Through various functional and performance tests, the aim is to ensure that the implemented functionalities meet the expected quality criteria, both in terms of correct behavior and efficiency.

First, there is a section dedicated to functional testing, whichcollects the results obtained after running various tests on thedeveloped functionalities. Secondly, there is a section focused on performance testing, which studies the efficiency of the software under certain conditions.

## **Content**

## **Functional Testing**

Functional testing was carried out to verify that #8 and #9 requirements behave according to the expected specifications. The tests were executed using .safe and .hack files that represent different input scenarios, including typical and boundary cases.

All test cases executed successfully, and no functional defects were detected during this phase:

8) Operations by **flight crew members** on **flight assignments**:

* List the flight assignments separately, one for completed flight legs and another one for those planned but that have not taken place yet.

|  |  |  |  |
| --- | --- | --- | --- |
| Feature | Description | File | Result |
| List flight assignments with planned legs | - Access the planned flight assignments with a flight crew member account. | list-planned.safe | High (100%) |
| - Attempting to access the planned flight assignments with a technician member account. | list-planned.hack |
| List flight assignments with completed legs | - Access the completed flight assignments with a flight crew member account. | list-completed.safe | High (100%) |
| - Attempting to access the completed flight assignments with a technician member account. | list-completed.hack |

* Show the details of their flight assignments and the associated legs and flight crew members.

|  |  |  |  |
| --- | --- | --- | --- |
| Feature | Description | File | Result |
| Show the details of a flight assignment | - Access to a published flight assignment with a flight crew member account.  - Access to a draft flight assignment with a flight crew member account. | show.safe | High (100%) |
| - Attempting to access a flight assignment with technician member account.  - Attempting to access a flight assignment that does not belong to a specific flight crew member.  - Attempting to access a flight assignment without an id provided.  - Attempting to access a flight assignment with an incorrect id. | show.hack |

* Create, update, and publish their flight assignments. Only crew members with duty “LEAD ATTENDANT” can perform these operations. Please, note that to publish a flight assignment these cannot be linked to legs that have already occurred. Additionally, only flight crew members with an "AVAILABLE" status can be assigned to a leg, and they cannot be assigned to multiple legs simultaneously. Lastly, each leg can only have one pilot and one co-pilot. ~~The allocation of remaining roles for other flight crew members is at the discretion of the “LEAD ATTENDANT”~~. Flight assignments can be updated or deleted as long as they have not been published.

**NOTE:** A flight assignment cannot be linked to legs that have already occurred. This is implemented on each authorise method due that if a user try to hack and introduce an invalid leg and does not belong to a set of valid legs is not authorised.

|  |  |  |  |
| --- | --- | --- | --- |
| Feature | Description | File | Result |
| Create a flight assignment | - Create a valid flight assignment.  - Attempting to create an invalid flight assignment, testing all the fields with incorrect data.  - Attempting to create a flight assignment with a leg that overlap with another leg timeframe.  - Attempting to create a flight assignment with a duty (pilot or copilot) and a leg that already contains a flight assignment with one pilot or copilot. | create.safe | High (100%) |
| - Attempting to access the create flight assignment view with technician member account.  - Attempting to create a flight assignment without and id provided.  - Attempting to create a flight assignment with and id provided different from 0.  - Attempting to create a flight assignment without a leg id provided.  - Attempting to create a flight assignment with a leg that does not belong to the available legs of that airline. | create.hack |
| Update a flight assignment | - Update a valid flight assignment.  - Attempting to update an invalid flight assignment, testing all the fields with incorrect data.  - Attempting to update a flight assignment with a leg that overlap with another leg timeframe.  - Attempting to update a flight assignment with a duty (pilot or copilot) and a leg that already contains a flight assignment with one pilot or copilot. | update.safe | High (100%) |
| - Attempting to access the update flight assignment view with technician member account.  - Attempting to update a flight assignment without and id provided.  - Attempting to update a flight assignment with and id provided that belongs to an existing published flight assignment owned by the flight crew member.  - Attempting to update a flight assignment with and id provided that belongs to an existing draft flight assignment not owned by the flight crew member.  - Attempting to update a flight assignment with and id provided that belongs to an existing published flight assignment not owned by the flight crew member.  - Attempting to update a flight assignment without a leg id provided.  - Attempting to update a flight assignment with a leg that does not belong to the available legs of that airline. | update.hack |
| Delete a flight assignment | - Detele a valid flight assignment. | delete.safe | High (100%) |
| - Attempting to access the delete flight assignment view with technician member account.  - Attempting to delete a flight assignment without and id provided.  - Attempting to delete a flight assignment with and id provided that belongs to an existing published flight assignment owned by the flight crew member.  - Attempting to delete a flight assignment with and id provided that belongs to an existing draft flight assignment not owned by the flight crew member.  - Attempting to delete a flight assignment with and id provided that belongs to an existing published flight assignment not owned by the flight crew member. | delete.hack |
| Publish a flight assignment | - Publish a valid flight assignment.  - Attempting to publish an invalid flight assignment, testing all the fields with incorrect data.  - Attempting to publish a valid flight assignment with an status different from “AVAILABLE”.  - Attempting to publish a flight assignment with a leg that overlap with another leg timeframe.  - Attempting to publish a flight assignment with a duty (pilot or copilot) and a leg that already contains a flight assignment with one pilot or copilot. | publish.safe | High (100%) |
| - Attempting to access the publish flight assignment view with technician member account.  - Attempting to publish a flight assignment without and id provided.  - Attempting to publish a flight assignment with and id provided that belongs to an existing published flight assignment owned by the flight crew member.  - Attempting to publish a flight assignment with and id provided that belongs to an existing draft flight assignment not owned by the flight crew member.  - Attempting to publish a flight assignment with and id provided that belongs to an existing published flight assignment not owned by the flight crew member.  - Attempting to publish a flight assignment without a leg id provided.  - Attempting to publish a flight assignment with a leg that does not belong to the available legs of that airline. | publish.hack |

9) Operations by **flight crew members** on **activity log records**:

* List the activity log records in their flight assignments.

|  |  |  |  |
| --- | --- | --- | --- |
| Feature | Description | File | Result |
| List activity logs | - Access the activity logs with a flight crew member account. | list.safe | High (100%) |
| - Attempting to access the activity logs with a technician member account.  - Attempting to access the activity logs without a flight assignment id provided.  - Attempting to access the actvity logs with an invalid flight assignment id.  - Attempting to access the activity logs with a flight assignment id provided that belongs to an existing planned draft flight assignment not owned by the flight crew member.  - Attempting to access the activity logs with a flight assignment id provided that belongs to an existing planned published flight assignment not owned by the flight crew member.  - Attempting to access the activity logs with a flight assignment id provided that belongs to an existing completed published flight assignment not owned by the flight crew member. | list.hack |

* Show the details of their activity log records.

|  |  |  |  |
| --- | --- | --- | --- |
| Feature | Description | File | Result |
| Show the details of an activity log | - Access to a published activity log with a flight crew member account.  - Access to a draft activity log with a flight crew member account. | show.safe | High (100%) |
| - Attempting to access the published activity log with a technician member account.  - Attempting to access the draft activity log with a technician member account.  - Attempting to access an activity log without a activity log id provided.  - Attempting to access an actvity logs with an invalid activity log id.  - Attempting to access the activity log with an id provided that belongs to an existing draft activity log not owned by the flight crew member.  - Attempting to access the activity log with an id provided that belongs to an existing published activity log not owned by the flight crew member. | show.hack |

* Create, update, delete and publish activity log records. They cannot be published if their corresponding flight assignments have not been published yet. No updating or deletion is possible once an activity log record has been published.

|  |  |  |  |
| --- | --- | --- | --- |
| Feature | Description | File | Result |
| Create an activity log | - Access to a published activity log with a flight crew member account.  - Access to a draft activity log with a flight crew member account. | create.safe | High (100%) |
| - Attempting to access the published activity log with a technician member account.  - Attempting to access the draft activity log with a technician member account.  - Attempting to access an activity log without a activity log id provided.  - Attempting to access an actvity logs with an invalid activity log id.  - Attempting to access the activity log with an id provided that belongs to an existing draft activity log not owned by the flight crew member.  - Attempting to access the activity log with an id provided that belongs to an existing published activity log not owned by the flight crew member. | create.hack |
| Update an activity log | - Update a valid activity log.  - Attempting to update an invalid activity log, testing all the fields with incorrect data. | update.safe | High (100%) |
| - Attempting to update a published activity log owned by the flight crew member.  - Attempting to update the published activity log with a technician member account.  - Attempting to update the draft activity log with a technician member account.  - Attempting to update an activity log without a activity log id provided.  - Attempting to update an actvity log with an invalid activity log id.  - Attempting to update the activity log with an id provided that belongs to an existing draft activity log not owned by the flight crew member.  - Attempting to update the activity log with an id provided that belongs to an existing published activity log not owned by the flight crew member. | update.hack |
| Delete an activity log | - Detele a valid activity log. | delete.safe | High (100%) |
| - Attempting to delete a published activity log owned by the flight crew member.  - Attempting to delete the published activity log with a technician member account.  - Attempting to delete the draft activity log with a technician member account.  - Attempting to delete an activity log without a activity log id provided.  - Attempting to delete an actvity log with an invalid activity log id.  - Attempting to delete the activity log with an id provided that belongs to an existing draft activity log not owned by the flight crew member.  - Attempting to delete the activity log with an id provided that belongs to an existing published activity log not owned by the flight crew member. | delete.hack |
| Publish an activity log | - Publish a valid activity log. | publish.safe | High (100%) |
| - Attempting to publish a published activity log owned by the flight crew member.  - Attempting to publish a draft activity log with flight crew member account.  - Attempting to publish the published activity log with a technician member account.  - Attempting to publish the draft activity log with a technician member account.  - Attempting to publish an activity log without a activity log id provided.  - Attempting to publish an actvity log with an invalid activity log id.  - Attempting to publish the activity log with an id provided that belongs to an existing draft activity log not owned by the flight crew member.  - Attempting to publish the activity log with an id provided that belongs to an existing published activity log not owned by the flight crew member. | publish.hack |

We will analyze the code coverage we have achieved thanks to the functional tests performed. Code coverage indicates what percentage of the source code has been executed during testing. This allows us to identify the areas that have been verified and those that have not yet been analyzed (which may contain undetected errors):

Interfaz de usuario gráfica, Aplicación, Tabla, Excel

Descripción generada automáticamente

**Figure 1** – Coverage of requirements #8 and #9

With regard to the functionalities of both entities (FlightAssignment and ActivityLog), we can see that they reach close to 100%. This implies that much of the code implemented to perform these functionalities is tested in case there is an error that has not been contemplated.

To justify the remaining 0.3% in Flight Assignments, I will explain which concepts have not been analyzed or taken into account:

Texto

Descripción generada automáticamente

**Figure 2** - Coverage of Delete functionality

The authorization method contemplated testing with two roles, one of which was suitable for authorization by the system. Although Eclipse was unable to capture this test, the request appears in the test log. The test log shows that the request was made, but Eclipse was unable to capture it. This problem appear also on all the classes with missed instructions.

## **Performance Testing**

Here we present the results obtained after running the functional tests, developed for requirements 8 and 9 of Student 3. The main objective is to evaluate the impact of the tests on response times, evaluate the performance of the software, and the performance of the hardware on each of the different devices.

To this end, several tests were carried out, an initial one without indexes and a subsequent one with the optimized indexes applied, measuring the average response times on two different devices: the work laptop and the personal PC.

**Exhibition on the results**

The results obtained by analyzing the log trace when running the launcher replay. During this process, the average response times of the different features were recorded, allowing statistics to be generated.

Based on the data obtained, the average response times showed anincrease, going from 20 ms before optimization to 24.64 ms after the implementation of indexes. However, given that the standard deviations in both cases are greater than 50 ms, the difference was not statistically significant at a 95% confidence level.

The two-tailed p-value is 0.275, which reinforces the assertion that there is insufficient evidence to claim that response times improved significantly, as this value is above the alpha threshold of 0.05 on device 1.

The 95% confidence intervals overlap:

Before the change: [16 ms, 24 ms]

After the change: [15 ms, 23 ms]

In contrast, device 2 shows that the average response times were drastically reduced compared to those of device 1. Regarding the initial case and the final case, with indices going from 13.41 ms before optimization to 13.08 ms after the implementation of indexes. However, given that the standard deviations in both cases are greater than 400 ms, the difference is not statistically significant at a 95% confidence level.

The two-tailed p-value is 0.696, which confirms that there was almost noimprovement from the initial version to the final version with indexes, since this value is above the alpha threshold of 0.05 on device 2.

The 95% confidence intervals overlap:

Before the change: [12.02 ms, 14.81 ms]

After the change: [11.64 ms, 14.4 ms]

The conclusions we can draw are that in neither of the two devices is there a substantial difference in improvement from the previous version to the later one with indices. In device 1, it is somewhat more noticeable but still above the alpha threshold of 0.05. Regarding response times, device 2 shows an improvement that affects the confidence intervals.

**Software performance with VisualVM**

To perform this test, VisualVM was used to identify the methods and classes that consume the most resources during execution, allowing the detection of possible bottlenecks that can be optimized through refactoring or index improvements. The results of this test show that the application is running smoothly and efficiently, with no significant bottlenecks or performance issues.

A detailed analysis of resource consumption at the class and method level can be observed during project execution. It allows you to visualize which parts of the code involve a greater workload, facilitating the identification of critical points in the system, including the unbind of ListPlanned (Flight Assignment), the unbind of Create (Flight Assignment), and the load/unbind of ListComplete (Flight Assignment). These methods can be improved through refactoring or improvements in database queries thanks to indexes, all with the aim of optimizing the application's performance.

**Device performance**

Finally, the overall performance of the system, specifically the hardware, was monitored during the execution of the tests, which provides a more complete view of the performance and load of the system on the two devices.

As can be seen, the performance on device 2 is similar to that of device 1 during the execution of the system functional tests. Both devices have no difficulty in coping with the tests, as there is no bottleneck in their hardware.

Based on the various tests performed, it can be concluded that device 2 (PC) performs substantially better than device 1 (laptop). The metrics obtained also show that response times are shorter and that it offers greater stability during the execution of functional tests. This shows that the PC, with its better hardware performance, responds much better to the workload of functional tests, making it a more suitable option for running this type of test.

## **Conclusions**

Since we want to evaluate the impact of functional tests and system performance, multiple functional tests were carried out, satisfying 99.9% coverage for the FlightAssignment and ActivityLog entities and their functionalities.

In performance testing, it can be stated that neither of the two devices showed statistically significant improvements in response times after the inclusion of indexes. Although in performance testing it can be stated that neither of the two devices showed statistically significant improvements in response times after the inclusion of indexes, in performance testing it can be stated that neither of the two devices showed statistically significant improvements in response times after the inclusion of indexes.

In performance testing, it can be stated that neither of the two devices showed statistically significant improvements in response times after the inclusion of indexes. Although the reduction was more noticeable on average on device 1, it was not sufficient to exceed the statistical confidence threshold of 0.05. On the other hand, device 2, thanks to its greater On the other hand, device 2, thanks to its greater processing capacity, offered lower overall response times, with less dispersion, thus confirming its technical superiority in terms of performance.

The 95% confidence intervals achieved by both devices are:

**Device 1:**

Before the change: [16 ms, 24 ms]

After the change: [15 ms, 23 ms]

**Device 2:**

Before the change: [12.02 ms, 14.81 ms]

After the change: [11.64 ms, 14.4 ms]

In addition, thanks to VisualVM, some MIRs (resource-intensive methods) were identified, representing additional opportunities for improvement, such as possible refactorings or redesign of the indexes applied in the entities as possible suggestions.

## **Bibliography**

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