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## TESTING REPORT

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# 1 Introduction

This chapter of the document aims to present the findings of the indepth testing done on the Gladios instance of the NavUP application. A test model was used for the various specifications of the core functions and innovations implemented.

## 1.1 Definitions, Acronyms, and Abbreviations

Table 1: Table of Definitions, Acronyms, and Abbreviations used in this document

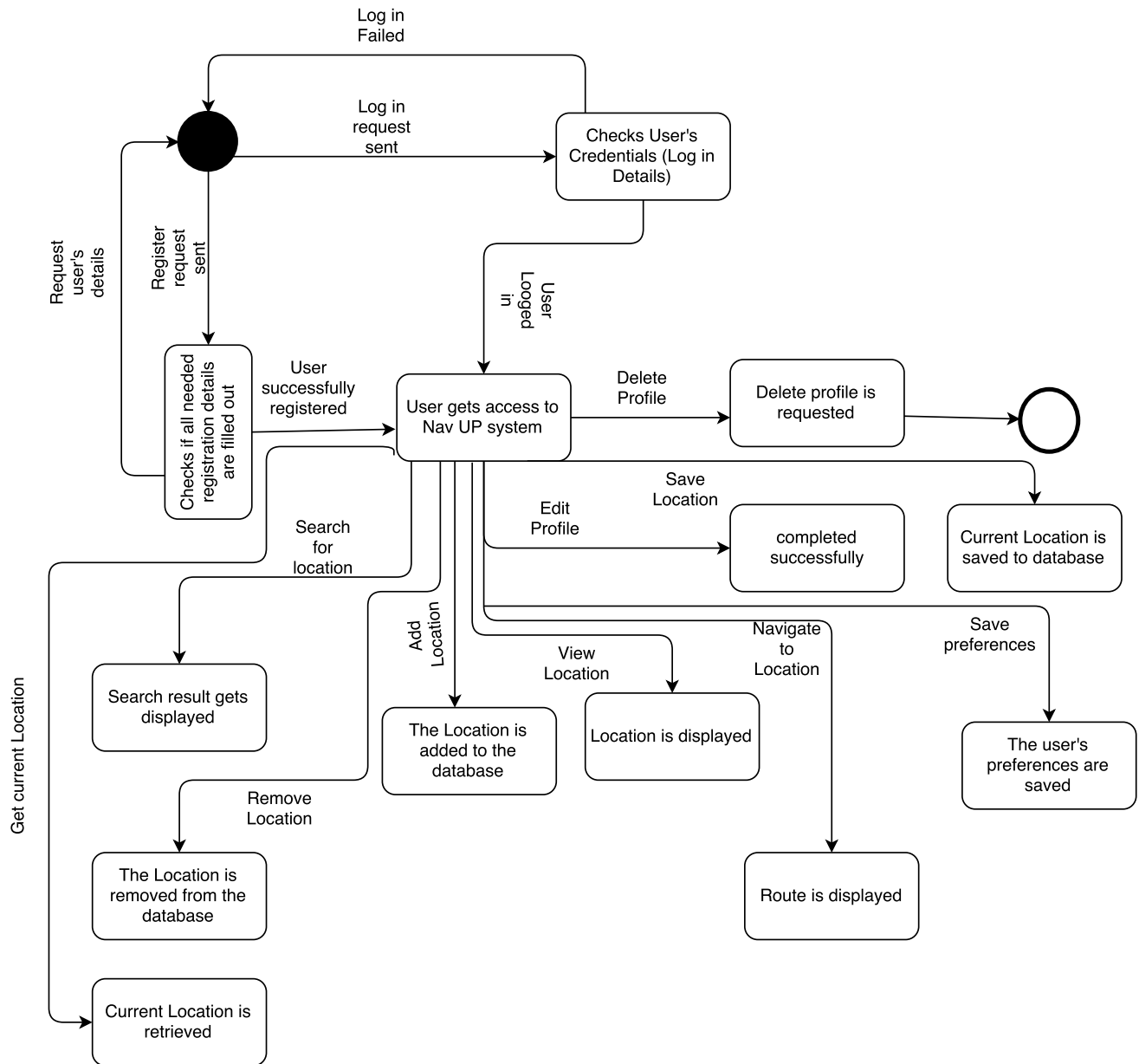
Term	Definition
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## 1.2 Overview

The remainder of this document will consist the test model used during testing, to functional requirements tested as well as the non-functional requirements tested.

<https://github.com/KeatonPennels/COS-301-Broadsword-Access>

## 2 Test Model



### **3 List of Service Contracts Tested**

NavUP is currently envisioned as a native mobile application that serves to navigate users around the Hatfield campus of the University of Pretoria. This application will be utilised by students, staff and visitors to the Hatfield campus in order to find their way around.

## 3.1 Users

### 3.1.1 User Registration

Input Element	Type	Value Specification	Valid	Invalid	Exceptional Cases
Username	String	A string that starts with a "u" followed by a number	Username satisfies the value specification and is not used by another user	Username does not satisfy value specification or the username already exists	Strings with length = 0 or very large lengths Strings with spaces, control characters or special characters
Full Name	String	Two separate strings containing at least one character each	Full name satisfies the value specification	Full name does not satisfy value specification	Strings with length = 0 or very large lengths Strings with spaces, control characters or special characters
Email	String	A string containing an "@@" as well as a valid domain	Email satisfies the value specification and is not used by another user	Email satisfies the value specification and is not used by another user	Strings with illegal special characters
Confirm Email	String	Match with email	Retyped email does match email	Retyped email does not match email	
Password	Password	The length must be 8 characters or more. It should contain a capital letter as well as a number	The password satisfies the password rule given on the left	The password does not satisfy the value specification	Passwords with length = 0 or very large lengths Password with spaces, control characters or special characters
Confirm Password	Password	Password matches original password	Match with password	Retyped password does not match password	

Figure 1: Input Values Required

Test Case	Username	Full name	Email	Confirm email	Password	Confirm Password	Expected outcome
1	Valid	Valid	Valid	Valid	Valid	Valid	show Registration Successful page
2	Valid	Valid	Valid	Valid	Valid	Invalid	show Error Message
3	Valid	Valid	Valid	Valid	Invalid	Valid	show Error Message
4	Valid	Valid	Valid	Valid	Exceptional	Valid	show Error Message
5	Valid	Valid	Valid	Invalid	Valid	Valid	show Error Message
6	Valid	Valid	Invalid	Valid	Valid	Valid	show Error Message
7	Valid	Valid	Exceptional	Valid	Valid	Valid	show Error Message
8	Valid	Invalid	Valid	Valid	Valid	Valid	show Error Message
9	Valid	Exceptional	Valid	Valid	Valid	Valid	show Error Message
10	Invalid	Valid	Valid	Valid	Valid	Valid	show Error Message
11	Exceptional	Valid	Valid	Valid	Valid	Valid	show Error Message

Figure 2: Test Cases



Test Case	Username	Full name	Email	Confirm email	Password	Confirm Password	Expected outcome	Actual outcome
1	"u14293324"	"Joe Soap"	"stephaniegroutsch@gmail.com"	"stephaniegroutsch@gmail.com"	"Stephanie1"	"Stephanie1"	show Registration Successful page	The registration was a success. A message is displayed to the user to indicate it was a success and the user is navigated back to the sign in page
2	"u14293324"	"Joe Soap"	"stephaniegroutsch@gmail.com"	"stephaniegroutsch@gmail.com"	"Stephanie1"	"Stephanie2"	show Error Message	The registration was not a success. A red border appears around the confirm password input box.
3	"u14293324"	"Joe Soap"	"stephaniegroutsch@gmail.com"	"stephaniegroutsch@gmail.com"	"steiff"	"steiff"	show Error Message	The registration was not a success. A red border appears around the password input box.
4	"u14293324"	"Joe Soap"	"stephaniegroutsch@gmail.com"	"stephaniegroutsch@gmail.com"	"Groutsch1 1"	"Groutsch1 1"	show Error Message	The registration was a success. A message is displayed to the user to indicate it was a success and the user is navigated back to the sign in page
5	"u14293324"	"Joe Soap"	"stephaniegroutsch@gmail.com"	"stephaniegroutsch@gmail.com"	"Stephanie1"	"Stephanie1"	show Error Message	The registration was not a success. A red border appears around the confirm email input box.
6	"u14293324"	"Joe Soap"	"s@jks123.shouldnotwork"	"s@jks123.shouldnotwork"	"Stephanie1"	"Stephanie1"	show Error Message	The registration was a success. A message appears to say the registration was a success and the user is navigated to the Login page
7	"u14293324"	"Joe Soap"	"s@jks@123.wrong"	"s@jks@123.wrong"	"Stephanie1"	"Stephanie1"	show Error Message	The registration was not a success. A red border appears around email input box.
8	"u14293324"	"Joe"	"stephaniegroutsch@gmail.com"	"stephaniegroutsch@gmail.com"	"Stephanie1"	"Stephanie1"	show Error Message	The registration was not a success. A red border appears around the Full name input box.
9	"u14293324"	"St3ff Groutsch"	"stephaniegroutsch@gmail.com"	"stephaniegroutsch@gmail.com"	"Stephanie1"	"Stephanie1"	show Error Message	The registration was a success. A message appears to say the registration was a success and the user is navigated to the Login page
10	"u"	"Joe Soap"	"stephaniegroutsch@gmail.com"	"stephaniegroutsch@gmail.com"	"Stephanie1"	"Stephanie1"	show Error Message	The registration was a success. A message appears to say the registration was a success and the user is navigated to the Login page
11	"@"	"Joe Soap"	"stephaniegroutsch@gmail.com"	"stephaniegroutsch@gmail.com"	"Stephanie1"	"Stephanie1"	show Error Message	The registration was a success. A message appears to say the registration was a success and the user is navigated to the Login page

Figure 3: Use Case Based Testing

**Additional comments:**  
Feedback in the form of text could have been given to indicate that

data needs to be filled in before a successful registration can be achieved.

More should be done in order to ensure that only users with unique usernames are allowed to register.

The system should ensure that users are not registered to the application if their given email address is already been used by another user. This is important since email addresses are used to sign into the application.

Since almost half of the registration tests failed, the awarded mark out of ten was reduced to five and a half. One mark was then subtracted from this mark since more feedback could have been given.

Total Mark: 4.5/10

### 3.1.2 User Login

Input Element	Type	Value Specification	Valid	Invalid	Exceptional Cases
Email	String	A string containing an "@" as well as a valid domain	Email satisfies the value specification and is not used by another user	Email satisfies the value specification and is not used by another user	Strings with illegal special characters
Password	Password	The length must be 8 characters or more. It should contain a capital letter as well as a number	The password satisfies the password rule given on the left	The password does not satisfy the value specification	Passwords with length = 0 or very large lengths Passwords with spaces, control characters or special characters

Figure 4: Input Values Required

Test Case	Email	Password	Expected outcome
1	Valid	Valid	show Login Successful page
2	Valid	Invalid	show Error Message
3	Valid	Exceptional	show Error Message
4	Invalid	Valid	show Error Message
5	Exceptional	Valid	show Error Message

Figure 5: Test Cases

Test Case	Email	Password	Expected outcome	Actual outcome
1	"stephaniegroutsch@gmail.com"	"Stephanie1"	show Login Successful page	The login was a success. A message saying the login was a success appears and the user is navigated to the navigation page
2	"stephaniegroutsch@gmail.com"	"InvalidPassword1"	show Error Message	The login was not a success. A message saying that either the email or password were invalid appears
3	"stephaniegroutsch@gmail.com"	"Stephanie 1"	show Error Message	The login was not a success. A message saying that either the email or password were invalid appears
4	"notRegistrerd@gmail.com"	"Stephanie1"	show Error Message	The login was not a success. A message saying that either the email or password were invalid appears
5	"steff@steff@gmail.com"	"Stephanie1"	show Error Message	The login was not a success. A message saying that either the email or password were invalid appears

Figure 6: Use Case Based Testing

**Additional Comments:**

Instead of the application taking the user to the navigation page once

they have logged in, they could instead be taken to a homepage.

The sign in can still be improved by giving the user more feedback when data is left blank.

Since the actual results of all of the test cases were the same as the expected results, the sign in should be awarded full marks. However, since the sign in can still be improved by giving the user more feedback when data is left blank, only 9/10 was awarded as there is still room for improvement.

Total Mark: 9/10

### 3.1.3 Edit Profile

Input Element	Type	Value Specification	Valid	Invalid	Exceptional Cases
Email	string	Valid email address format	The email address satisfies the email address format	Email address not in the required format; No Input; Email address already in use	N/A
Full Name	string	Any space separated string	Any space separated string	No Input;	N/A

Figure 7: Input Values Required

Test case	Email	Full name	Expected Outcome
1	Valid	Valid	Profile update successful
2	Invalid	Invalid	Profile update failed. No input error message displayed
3	Invalid	Valid	Profile update failed. Invalid email related error message.

Figure 8: Test Cases

Test case	Email	Full name	Expected Outcome	Actual outcome
1	U15071830@tuks.co.za	Munyayradzi Mpofu	Profile update successful	Profile update successful
2			Profile update failed. No input error message displayed	Profile update failed. A red border appears around the input fields.
3		Munyayradzi Mpofu	Profile update failed. Invalid email related error message.	Profile update failed. A red border appears around the input fields.

Figure 9: Use Case Based Testing

**Additional comments:**

A possible improvement could be to add an input field to the "Edit Profile" page for the user to change their password.

Since three of the five test cases actual results were not the same as the expected result, the awarded mark out of ten was initially four. Since one has to navigate to another page to change their password, another mark was deducted.

**Total Mark: 3/10**

#### **3.1.4 Delete Profile**

N/A

### **3.2 GIS (GIS Management)**

Test Case	Action	Expected result	Actual result
1	The admin user presses the "Manage GIS" button	The application displays an interface for the admin user to manage locations	The application displays a list of location names. It is assumed that this is a representation of GIS objects

Figure 10: Input Values Required

#### **3.2.1 View GIS Data**

**Additional comments:**

The application is intended to display an interface, which an admin user can use to manage GIS locations, but instead it only provides a list of locations and no options to make any changes to these objects.

**Total Mark: 2/10**

#### **3.2.2 Add GIS Data**

N/A

#### **3.2.3 Edit GIS Data**

N/A

#### 3.2.4 Remove GIS Data

N/A

### 3.3 Points of Interest (Location Access)

Test Case	Action	Expected result	Actual result
1	The search icon is pressed with the intent of searching for a location on the map	The application displays an input field in which the user can enter a location name and search for it	The application displays a list of location names

Figure 11: Input Values Required

#### 3.3.1 Search Location

**Additional comments:**

The application could offer a search bar, which the user can use to search for a specific location.

Total Mark: 2/10

#### 3.3.2 Save Location

N/A

#### 3.3.3 Get Current Location

Test Case	Action	Expected result	Actual result
1	The "Get Current Location" button is pressed	The application will mark the user's current location on the map	The application marks a location on the map which is not the current user's location

Figure 12: Input Values Required



**Additional comments:**

The application marks a location on the map, although this location is not the correct location. This would lead to incorrect locations being saved, and could also affect the process of navigating from the users current location to another location.

Since the only test case failed, a mark of zero would be awarded however, the page is pleasing to look at which resulted in an additional two marks being added.

Total Mark: 2/10

### **3.4 Points of Interest (Location Management)**

#### **3.4.1 View Locations**

N/A

#### **3.4.2 Add location**

N/A

#### **3.4.3 Modify Location**

N/A

#### **3.4.4 Remove Location**

N/A

### **3.5 Navigation**

#### **3.5.1 Navigate to Location**

N/A

#### **3.5.2 Save Preferences**

N/A

## **4 List of Functional Requirements Tested**

This chapter aims to give an overview of the entire NavUP system. The system will be contextualised in order to demonstrate the basic functionality of the system as well as demonstrate how the system interacts with other systems. It will also describe the levels, or types, of users that will utilise the system and describe the functionality that is available to said user. At the end of this chapter, the constraints and assumptions for the system will be addressed.

- Create route to valid location
- Save routes
- Heat maps
- Current user location
- Save locations
- Search for locations
- Report protest action or emergency
- Create public event
- View all locations
- Request addition, removal, or modification of locations
- Register as student, staff, admin or guest
- Login
- Manage user accounts
- Add profile information

## 5 List of Non-Functional Requirements Tested

### 5.1 Performance requirements:

#### 5.1.1 Performance:

- Offline activities should have a response time of  $\pm 2$  seconds (instantaneous) when responding to an activity, while online activities such as calculating routes should have a response time of  $\pm 2-4$  seconds so that the users have an uninterrupted experience.
- It should also allow the integration of a variety of services.

#### 5.1.2 Reliability:

- The application should be reliable, in that it will provide the fastest route every time without fail and complete all other computations successfully.
- All activities should be completed with a 10
- The application should provide accurate locations in a constantly changing environment.

### **5.1.3 Security:**

- Data transmission should be securely transmitted without unauthorized access, or loss of information.

## **5.2 Design Constraints:**

- The system should be accessible on smart devices, such as Android and iOS devices.
- The system should not use GPS, but only the WiFi network.
- The proposed system should be able to be integrated into the Computer Science Department's Web site.
- The system should be a modular system, to reduce the dependencies in the system.
- Software Fault Tolerance: If a malfunction cannot be avoided, then the software design should be constrained so that the system can recover without causing damage to the system.
- The system should have an aesthetically pleasing and easy to use interface.
- The system must be able to run on smart devices which has limited processing power, battery life and storage space. The system must thus use resources efficiently.
- The system needs to use open source technologies.

## **5.3 Software System Attributes:**

- Users should have the option to withdraw all information gathered by the system.
- The system should be available online as well as offline.
- The system should stay updated, to ensure reliable information. For instance the maps of campuses should be updated regularly.
- The system should easily be updated, without complications.
- The system should be managed efficiently, checking for problems regularly.
- The system should be secure to prevent unauthorized modification or access of information.
- The system should be user-friendly, the application should meet the requirements of the user by providing good access for disabled users, and resulting in a good overall user experience.

## 6 Evaluation of Test Cases for Non-Functional Requirements

### 6.1 Security

#### Password Protection

**Action:** Attempt to circumvent the password protection

**Expected Result:** The password protection should be secure and impervious to circumvention.

**Actual Result:** The password protection at the login screen is secure and doesn't allow users to login unless their password is correct. The Profile Management page however has a loophole when changing passwords though, in that it allows users to change passwords even if the password they enter into the Old Password field (for authentication) is incorrect.

**Possible Improvements:** The app should lock down the profile if the password is entered incorrectly too many times. The profile can then remain locked until an authentication email is sent to the user allowing them to unlock their profile.

**Mark:** 7/10

#### SQL Injection

**Action:** Attempt to inject SQL code into the database

**Expected Result:** The SQL injection should be blocked by escaping the special characters entered.

**Actual Result:** The SQL injection couldn't be tested because none of the data entered is persisted to a database. However, no code was found to sanitize harmful characters from user input before passing it to the user module.

**Possible Improvements:** The app could escape characters before passing it to the user module.

**Mark:** 2/10

### 6.2 Stability

#### Crash Testing

**Action:** Attempt to crash the Access module through overloading input.

**Expected Result:** The app will remain running.

**Actual Result:** The app avoided crashing but was slowed down to an extent by the large amount of input.

**Possible Improvements:** The app should implement a character limit on input fields to fully guard against this issue.

**Mark:** 8/10

### 6.3 Accessibility

#### **Support for disabilities with routes**

**Action:** Does the app provide an option for routes that are friendly to people with disabilities?

**Expected Result:** The app does provides such a feature with routes that avoid stairs and follow wheelchair-friendly routes.

**Actual Result:** The app does not provide such a feature.

**Mark:** N/A

#### **Support for colour-blindness**

**Action:** Does the app provide an option to present the User Interface in a manner that is colour-blind friendly?

**Expected Result:** The app has options for different kinds of colour-blindness.

**Actual Result:** The app doesn't provide support for different kinds of colour-blindness.

**Mark:** N/A

### 6.4 Performance Testing

A iPhone 6 with the below specifications were used in order to conduct the various performance testing

Specifications: Operating System - iOS 10.3

Chipset - Apple A8

CPU - Dual Core 1.4 GHz

RAM - 1GB DDR3

Storage - 32GB

The below table displays the performance statics gathered when running the NavUP application on the above device. The respective functionality was conducted 10 times and then an average of these cases were recorded in the Measure column. Recorded statistics were taken from the XCode debugging suite.

Table 2: Table of collected data for Performance testing

Functionality	Description	Measurement
Application launch	Time taken for home screen to load when application is opened	1.42 seconds
	Initial memory usage when application is launched	118.3 MB
	Initial percentage of CPU used when application is launched	0.8 %
	Amount of data read when application is launched	40 KB
	Amount of data read when application is launched	300 KB
Registration	Time taken to register a new user	0.7 seconds
	Memory increase when new user is registered	57.9 MB
	Amount of data written when new user is registered	1.2 MB
Profile Management	Time taken to update user details	0.2 seconds
	Memory increase when new user is registered	10.6 MB
	Amount of data read when user profile is displayed	200 KB
	Amount of data that was written when user details were updated	0.64 MB

We were unable to test the navigation with relation to performance as its functionality was not available to us. It was estimated that this would incorporated a large part of the applications performance requirements in terms of memory and CPU usage

**Mark** = 9/10

Comment: The Gladios instance of the NavUP application performs well in terms of time taken for the application the execute user tasks. As this is the majority concern for all 3 user groups, this instance meets the requirements in terms of performance. The memory and CPU time required by the application is in general quite low which allows it to perform well even when other applications are running on a device. It would have been preferable if the performance requirements of navigation could have been tested in order to gauge how the application performs under general usage conditions.

## 6.5 Usability Testing

The Gladios instance of NavUp usability testing was evaluated in terms of 3 key components: **Effectiveness** (Whether or not the user's goal was achieved), **Efficiency** (Whether a user's goal is achieved in a proficient manner) and **Aesthetics** (Whether the look and feel adhered and/or enhances applications purpose).

The user's goals that were taken into consideration was that of all 3 different user groups of the NavUP application. All tasks were derived from the model Requirements Specifications. Upon completion of these 3 user groups interacting with the application, the following results were gathered.

**Effectiveness** - Guest and General users were able to carry out all tasks related to the core functionality required of the NavUP application whereas Admin users were not provided with required User and GIS administrative functionality. This was not seen as a major shortcoming in terms of effectiveness as the majority of administrative functionality would take place on the Web instance of the NavUP application. Tasks involving Add On functionality were sparsely implemented for all 3 user groups with only basic navigation functionality being provided to the users

**Efficiency** - The application provides a simple user interface and requires only basic touch, swipe and type interactions. The majority of functionality is reachable to the user within the range of 3 to 5 clicks/touches. Where the app lacks in efficiency is in two areas: 1) a call to action for the user upon launching the application was absent. The user was required to open a descriptionless menu tab in order being interaction and 2) providing guiding prompts to direct the user's interaction with the application. Users were not informed of incorrect inputs and struggled when registering, logging in and searching.

**Aesthetics** - The user is presented with interface whose colour scheme is in conjunction with that of the University of Pretoria. This along with the structure of components within the application being similar to that of other popular navigation applications such as Google Maps and Waze Maps ensured that interactions would be intrinsically familiar to the user. All menus and search interactions were formatted consistently throughout the applications which prevented confusion and allowed for the user to become familiar with the user interface

**Mark** = 7/10

Comment: All three user groups have access to almost all of the core functionality and some of the add on functionality which facilitates the completion of user goals and tasks. Minor adjustments such as improvements to the navigation functionality to allow for a more in-depth searching of locations and route calculations. Error messages and user prompts can also be more elegantly designed in order to facilitate correct interactions with the application. Other than these few points, the Gladios instance of the NavUP application is generally usable from a user perspective and provides an enjoyable interactions