



# simpli-city

The Road User Information System Of The Future

## WP8 – Use Case II: Enhancing the Driving Experience

### D8.3: Evaluation Report

Document Lead: FGM

Contributing Partners: CRF, WORLD

Delivery Date: 10/2015

Dissemination Level: Public

Version 1.0

#### Short Abstract (Teaser)

This document provides an overview of the evaluation approach taken within WP8 of SIMPLI-CITY, and describes the results of the evaluation of the Use Case II related SIMPLI-CITY Apps.



Document Status	
<b>Deliverable Lead</b>	Michaela Kargl, FGM
<b>Internal Reviewer 1</b>	Freddy Lecue, IBM
<b>Internal Reviewer 2</b>	Philipp Hoenisch, TUV
<b>Type</b>	Public Deliverable
<b>Work Package</b>	WP8 Use Case II: Enhancing the Driving Experience
<b>ID</b>	D8.3 Evaluation Report
<b>Due Date</b>	30.09.2015
<b>Delivery Date</b>	30.10.2015
<b>Status</b>	For Approval

Document History	
<b>Contributions</b>	V0.1, Michaela Kargl (FGM), 18.08.2015, Document structure. V0.2, Michaela Kargl (FGM), 20.08.2015, added chapters 2 and 3 and Annexes V0.3, Doris Wiederwald (FGM), 24.08.2015, added chapter 4.1 V0.4, Markus Schuster (FGM), 22.09.2015, added chapters 4.2 and 4.3 V0.5, Michaela Kargl (FGM), 25.09.2015, added chapter 5.1 V0.6, Michaela Kargl (FGM), 28.09.2015, added chapter 5.2 V0.6.1, Michaela Kargl (FGM), 12.10.2015, updated according to internal review V0.7, Michaela Kargl (FGM), 29.10.2015, added chapters 5.3 and 6 V1.0, Michaela Kargl (FGM), 30.10.2015, finalised version
<b>Final Version</b>	October 30, 2015 (M37)

## Note

*This deliverable is subject to final acceptance by the European Commission.*

## Disclaimer

*The views represented in this document only reflect the views of the authors and not the views of the European Union. The European Union is not liable for any use that may be made of the information contained in this document.*

*Furthermore, the information is provided “as is” and no guarantee or warranty is given that the information is fit for any particular purpose. The user of the information uses it at its sole risk and liability.*

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 2 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

## Project Partners



Vienna University of Technology (Coordinator),  
Austria



Ascora GmbH, Germany



TIE Nederland B.V., The Netherlands



Technische Universität Darmstadt, Germany



IBM Research – Ireland  
Smarter Cities Technology Centre



Forschungsgesellschaft Mobilität, Austria



Talkamatic AB, Sweden



Atos Worldline, Spain



Centro Ricerche FIAT, Italy



SRM – Reti e Mobilità, Italy

## Executive Summary

Within the SIMPLI-CITY project, evaluation was assigned to the two tasks T7.3 and T8.3 responsible for the evaluation of the Use Case I and Use Case II related parts of the SIMPLI-CITY system respectively. The evaluation activities related to SIMPLI-CITY's market places and SIMPLI-CITY's developer tools as well as the Technical Evaluation of the whole SIMPLI-CITY system, which were done in close cooperation of both evaluation tasks T7.3 and T8.3, are described in detail in deliverable D7.3.

This document D8.3 Evaluation Report includes a detailed description and the results of the evaluation activities related to the two Use Case II related SIMPLI-CITY apps.

As can be seen from Table 1, Technical Evaluation showed that most of the Use Case II specific requirements were completely fulfilled by the prototypes developed within SIMPLI-CITY. Two of these requirements were partially fulfilled.

The Usability Evaluation was seen as formative evaluation: in order to allow the SIMPLI-CITY developers to implement further improvements to the system based on the findings of the evaluation, Usability Evaluation was conducted in phases starting from June 2015 to September 2015. For both Use Case II related SIMPLI-CITY apps several useful hints for improvement of their usability were obtained by the usability evaluation. Many of these improvements suggested by the results of the usability evaluation were implemented by the SIMPLI-CITY developers immediately. However, of course not all usability issues could be solved during the runtime of the project, but the remaining usability issues are well documented and constitute valuable contributions for further developments of the SIMPLI-CITY prototypes.

## Table of Contents

1	Introduction .....	6
1.1	SIMPLI-CITY Project Overview .....	6
1.2	Deliverable Purpose, Scope and Context.....	7
1.3	Document Status and Target Audience .....	7
1.4	Abbreviations and Glossary .....	7
1.5	Document Structure.....	7
2	Evaluation Approach taken within WP8 .....	8
2.1	Supportive Material Created for Usability Evaluation.....	9
3	Technical Evaluation related to Use Case II .....	10
4	Evaluation of the Use Case II.1 Related App.....	11
4.1	Usability Inspection of the Use Case II.1 related App.....	11
4.2	Usability Evaluation of the Use Case II.1 related App .....	18
4.3	Functional Evaluation of the Use Case II.1 related App .....	30
5	Evaluation of the Use Case II.2 Related App.....	38
5.1	Usability Inspection of the Use Case II.2 related App.....	38
5.2	Usability Evaluation of the Use Case II.2 related App .....	44
5.3	Functional Evaluation of the Use Case II.2 related App .....	56
6	Summary and Conclusions .....	64
	Annex A: Task Sheets for Usability Evaluation, Use Case II.1 related App .....	65
	Annex B: Task Sheets for Usability Evaluation, Use Case II.2 related App .....	67
	Annex C: Briefing Notes for Usability Inspection, Use Case II.1 Related App .....	69
	Annex D: Briefing Notes for Usability Evaluation, Use Case II.1 Related App .....	78
	Annex E: Moderator Cheat Sheet for Usability Evaluation .....	92

# 1 Introduction

SIMPLI-CITY – The Road User Information System of the Future – was a project funded by the Seventh Framework Programme of the European Commission under Grant Agreement No. 318201. Its results provide the technological foundation for bringing the “App Revolution” to road users by facilitating data integration, service development, and end user interaction.

This deliverable describes the approach taken regarding evaluation in WP8. It outlines the evaluation strategy, gives an overview of the evaluation activities undertaken, and describes the results of the evaluation of the Use Case II related SIMPLI-CITY Apps in detail.

## 1.1 SIMPLI-CITY Project Overview

Analogously to the “App Revolution”, SIMPLI-CITY adds a “software layer” to the hardware-driven “product” mobility. SIMPLI-CITY takes advantage of the great success of mobile apps that are currently being provided for systems such as Android, iOS, or Windows Phone. These apps have created new opportunities and even business models by making it possible for developers to produce new apps on top of the mobile device infrastructure. Many of the most advanced and innovative apps have been developed by players formerly not involved in the mobile software market. Hence, SIMPLI-CITY supports third party developers to efficiently realise and sell their mobility-related service and App ideas by a range of methods and tools, including the Mobility Services and App Marketplaces.

In order to foster the wide usage of those services, a holistic framework is needed which structures and bundles potential services that could deliver data from various sources to road user information systems. SIMPLI-CITY provides such a framework by facilitating the following main project results:

- **Mobility Services Framework:** A next-generation European Wide Service Platform (EWSP) allowing the creation of mobility-related services as well as the creation of corresponding apps. This enables third party providers to produce a wide range of interoperable, value-added services, and apps for drivers and other road users.
- **Mobility-related Data as a Service:** The integration of various, heterogeneous data sources like sensors, cooperative systems, telematics, open data repositories, people-centric sensing, and media data streams, which can be modelled, accessed, and integrated in a unified way.
- **Personal Mobility Assistant:** An end user assistant that allows road users to make use of the information provided by apps and to interact with them in a non-distracting way – based on a speech recognition approach. New apps can be integrated into the Personal Mobility Assistant in order to extend its functionalities for individual needs.

To achieve its goals, SIMPLI-CITY conducted original research and applied technologies from the fields of Ubiquitous Computing, Big Data, Media Streaming, the Semantic Web, the Internet of Things, the Internet of Services, and Human-Computer Interaction. For more information, please refer to the project website at <http://www.simpli-city.eu>.

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 6 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

## 1.2 Deliverable Purpose, Scope and Context

The purpose of this deliverable is to outline the evaluation approach taken within WP8 of the project SIMPLI-CITY, to describe the evaluation related activities conducted by the consortium, and to provide a detailed overview of the results of these evaluation activities.

## 1.3 Document Status and Target Audience

This document is listed in the Description of Work (DoW) as “public”. The results of the evaluation activities conducted within WP8 of the SIMPLI-CITY project might be interesting for all parties, who want to use and exploit (parts of) the SIMPLI-CITY system, since these evaluation results give valuable hints for further improvement of the system.

## 1.4 Abbreviations and Glossary

A definition of common terms and roles related to the realization of SIMPLI-CITY as well as a list of abbreviations is available in the supplementary document “Supplement: Abbreviations and Glossary”, which is provided in addition to this deliverable.

Further information can be found at <http://www.simpli-city.eu>.

## 1.5 Document Structure

This deliverable is broken down into the following sections:

Section 1 provides an introduction for this deliverable including a general overview of the project, and outlines the purpose, scope, context, status, and target audience of this deliverable.

Section 2 outlines the evaluation approach taken within WP8 of the SIMPLI-CITY project.

Section 3 gives an overview of the results of the Technical Evaluation related to Use Case II.

Section 4 describes the evaluation of the Use Case II.1 related App.

Section 5 provides details for the evaluation of the Use Case II.2 related App.

Section 6 summarises the evaluation results.

The Annexes of this document include material, such as task sheets and briefing notes, which were created to support the evaluation activities.

## 2 Evaluation Approach taken within WP8

The evaluation strategy followed within WP8 aimed to reach two main objectives:

- to evaluate the Use Case II related prototypes developed within SIMPLI-CITY against the requirements specified within deliverable D2.3 “Requirements Analyses Report”
- to validate the applicability of the Use Case II related prototypes in a real-world setting

In order to reach these objectives, the evaluation strategy combined elements of technical evaluation, usability evaluation, and functional evaluation: Technical Evaluation looked at the grade of fulfilment of the requirements specified within deliverable D2.3. Usability Evaluation and Functional Evaluation looked at the usability and the functionality of the SIMPLI-CITY prototypes from users’ point of view.

Within the SIMPLI-CITY project, evaluation was assigned to the two tasks T7.3 and T8.3 responsible for the evaluation of the Use Case I and Use Case II related parts of the SIMPLI-CITY system respectively. As shown in Figure 1, evaluation of those parts of the SIMPLI-CITY system, which were relevant for both use cases (i.e., SIMPLI-CITY’s market places and SIMPLI-CITY’s developer tools), was conducted in close cooperation of both evaluation tasks T7.3 and T8.3.

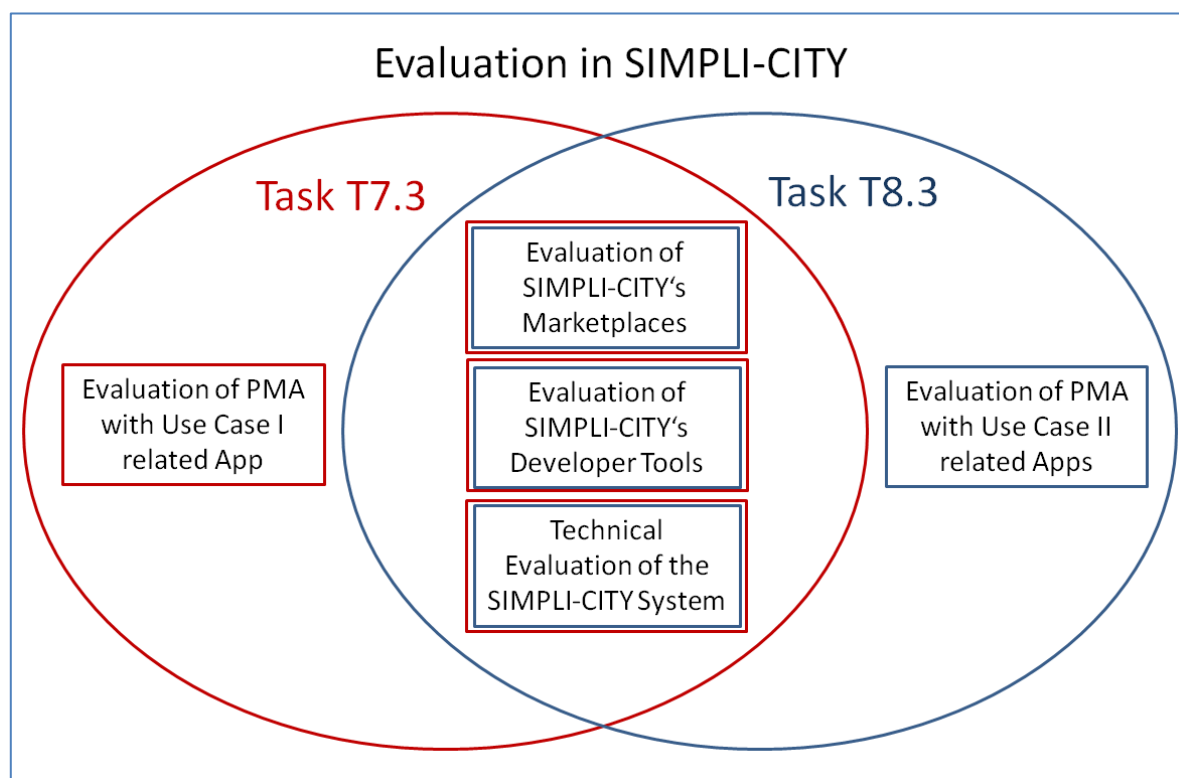


Figure 1: Evaluation Tasks in SIMPLI-CITY

In addition to these “common” evaluation activities mentioned above, which were done in close cooperation with task T7.3, in task T8.3 the evaluation of the PMA with the Use Case II related SIMPLI-CITY apps was carried out. There were two Use Case II related apps developed within SIMPLI-CITY: an App called “Eco Assistant”, which is related to Use Case Topic II.1 “Environmental Awareness Rising”, and an App called

“Enhanced Driving Experience”, which is related to Use Case Topic II.2 “Rising the Drivers Comfort”. For each of these two apps evaluation activities included Usability Inspection by experts, Usability Evaluation by test-users, and Functional Evaluation. The following sections of this document provide a detailed description of these evaluation activities as well as their results.

More information about the “common” evaluation activities, i.e., evaluation of SIMPLI-CITY’s market places and SIMPLI-CITY’s developer tools as well as the Technical Evaluation of the whole SIMPLI-CITY system, which were carried out in close cooperation of the evaluation tasks T7.3 and T8.3, can be found in deliverable D7.3 Evaluation Report.

## 2.1 Supportive Material Created for Usability Evaluation

In order to facilitate the preparation, organisation and conduction of the usability evaluation activities in SIMPLI-CITY, a set of material was created, which was then specifically adapted to the different evaluation areas (SIMPLI-CITY developer tools, App Marketplace, Use Case I related app, Use Case II.1 related app, and Use Case II.2 related app). For each of these evaluation areas the material set included:

- The “Briefing Notes for the Usability Inspection” explained the process to follow for the Usability Inspection in detail
- An “Evaluator’s Template” Excel Sheet helped to gain structured information from the experts, who conducted the Usability Inspection.
- The “Briefing Notes for the Usability Evaluation” explained the process to follow for the organisation and conduction of the Usability Evaluation in detail
- A “Moderator Cheat Sheet” was a step-by-step guide for the moderator of the usability evaluation sessions.
- Also templates for the task sheets, the participant consent form, the introduction questionnaire, and the feedback questionnaire were developed.

Examples of the “Briefing Notes for Usability Inspection”, the “Briefing Notes for the Usability Evaluation”, and the “Moderator Cheat Sheet”, which were developed for the Usability Inspection/Evaluation of the Use Case II.1 related SIMPLI-CITY app, are included in Annex C, Annex D, and Annex E of this document respectively.

### 3 Technical Evaluation related to Use Case II

At the beginning of the project, during the specification phase of the SIMPLI-CITY system, in total 212 requirements were defined in deliverable D2.3 Requirements Analysis Report. 12 of these were specific requirements for Use Case II.

In order to be able to assess to which grade the prototypes developed within the SIMPLI-CITY project fulfil these requirements, a Technical Evaluation Questionnaire was prepared at the end of the project. In this questionnaire the developers of the SIMPLI-CITY prototypes were asked to state for all requirements, whether they were fulfilled completely, partially, or not at all. The complete results of the Technical Evaluation Questionnaire can be found in deliverable D7.3 Evaluation Report.

Table 1 shows the results of the Technical Evaluation Questionnaire for the 12 Use Case II specific requirements. As can be seen from Table 1, most of these requirements were completely fulfilled by the prototypes developed within SIMPLI-CITY.

Table 1: Grade of Fulfilment of the Use Case II Specific Requirements

Use Case II Specific Requirement		completely fulfilled			Explanation why not or only partially implemented
		yes	partly	no	
U201	Provision of personalized info, e.g. travel, costs	x			
U209	Provision of real-time information about the current route	x			
U211	Reproduction of streaming audio	x			
U213	Social network integration	x			
U214	Reporting to the end user about eco-driving information	x			
U215	Vehicle information available to the system	x			
U216	Provision of real time feedback to the user in order to improve his/her performance	x			
U217	Access to a journey-related eco-driving data using the specific web portal	x			
U218	Comparing (eco-)performances of different drivers	x			
U219	Reward drivers through the eco-driving contest	x			
U210	Reproduction of multimedia information		x		Only images of the route and audio feedback are provided as other streams are not supported
U212	Notification to end user about the proximity of Points of Interest (POIs)		x		No updates are sent to the PMA as this is not supported by the PMA. There's no automatic update, but the user needs to request updates manually.

## 4 Evaluation of the Use Case II.1 Related App

The evaluation activities performed with respect to the Use Case II.1 related SIMPLI-CITY App included Usability Inspection by experts (see Section 4.1), Usability Evaluation by test-users (see Section 4.2), and Functional Evaluation (see Section 4.3).

### 4.1 Usability Inspection of the Use Case II.1 related App

This chapter presents the results of the Usability Inspection of the Use Case II.1 “Environmental Awareness Rising” related SIMPLI-CITY App. The Usability Inspection of this SIMPLI-CITY App has taken place in July 2015 in Orbassano, Turin.

In Section 4.1.1 the Usability Inspection approach is described briefly. Section 4.1.2 gives a summary of the results of the Usability Inspection, and Section 4.1.3 outlines the findings in detail.

#### 4.1.1 Approach taken for the Usability Inspection

##### 4.1.1.1 Aim of the Usability Inspection

This Usability Inspection was done in order to reveal potential usability issues of the SIMPLI-CITY App “Eco Live Assistant” and the SIMPLI-CITY PMA. The results of this Expert Evaluation give valuable hints for further improvement of the SIMPLI-CITY system.

##### 4.1.1.2 Team of Evaluators

Name	Organisation	Professional Background
Cristina Zoldan	Crf - Fiat Research Center	HMI – Innovative User Interface – Head of group
Antonella Masala	Crf - Fiat Research Center	HMI designer
Enrica Deregibus	Crf - Fiat Research Center	HMI expert in vocal interaction

##### 4.1.1.3 Context Information

###### *Product*

The SIMPLI-CITY App “Eco Live Assistant” provides a set of services aimed to improve the user’s eco driving behaviour. The Eco Live Assistant offers:

- a Trip Assistant able to supply current trip information
- suggestion about possible Alternative Eco Routes
- continuous monitoring of the eco driving progress and comparison with the score achieved previously, when travelling the same route, in order to stimulate a continuous self-improvement
- access to all historical information about travelled trips and driving style

### Users

It is expected that users of this product are environmentally conscious car drivers, who, while possessing a private car, aim to minimise the impact of the vehicle on the environment.

It is assumed that the users of this product have the following relevant skills, knowledge, and experience:

- familiar with using Apps on the Smartphone
- users of the English version of the App: good English language skills (but not necessarily English native speaker)
- users of the Italian version of the App: good Italian language skills

### Tasks

The main tasks that users perform with this product are:

- Show my next trip using car position and information from my agenda (task to be done before the trip)
- Find an alternative route that allows to maximise my eco-score (task to be done before the trip)
- Improve my eco-score along my commuting route (task to be done during the trip)
- Browse my trip history (Task to be done not during the trip)

### Test Environment

The Usability Inspection was done in CFR's laboratory (i.e. under laboratory conditions, not while driving), where a workbench provided the following technical environment:

- A NEXUS 5 Smartphone with Android 4.4.2 operating system, where the SIMPLI-CITY PMA and Apps as well as a car connector developed by CRF for enabling the communication with the FIAT telematics platform were installed
- The Smartphone was connected via Bluetooth to the test car's telematics platform able to provide real car signals for feeding properly the car sensor
- The Smartphone was connected via Wi-Fi to the MMDI server and to the SRE server

#### 4.1.1.4 Method Applied

For the Expert Evaluation of the SIMPLI-CITY App "Eco Live Assistant", the well-established Usability Inspection method "*Heuristic Evaluation*" was applied:

At the core of the usability inspection method "Heuristic Evaluation" is the evaluation of a user interface with reference to a checklist of heuristic usability design rules in order to reveal key user interface issues.

Three evaluators examined the SIMPLI-CITY App and assessed its compliance with the "*Usability Heuristics for touchscreen-based mobile devices with voice-based user interfaces*" listed below. In addition, the experts recruited in CRF also considered the compliance with the major guidelines and best practice applied in FIAT for the building of HMI usable in the car environment. The evaluators followed the task-based Heuristic Evaluation methodology, and examined the App by following the user's main tasks as listed in the context information table above. The evaluators were advised to work alone,

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 12 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

without communicating with the other evaluators, and delivered a list of their positive findings as well as a list of the potential usability issues they had revealed. The evaluators' individual lists were consolidated and combined into the "heuristic evaluation report", which can be found in Section 4.1.3 of this document.

#### 4.1.1.5 List of Heuristics

The list of heuristic usability principles is at the core of the "Heuristic Evaluation" method. For the Heuristic Evaluation of the SIMPLI-CITY App, the evaluators used the following set of 12 usability principles as reference. This list of "*Usability Heuristics for touchscreen-based mobile devices with voice-based user interfaces*" (see Table 2) is compiled based on Jakob Nielsen's "10 general principles for interaction design"<sup>1</sup>, the "Usability Heuristics for Touchscreen-based Mobile Devices"<sup>2</sup>, the "Usability Checklist for Voice-based User Interfaces"<sup>3</sup>, and Gerry Gaffney's "Voice Interaction Checklist"<sup>4</sup>.

Table 2: Usability Heuristics Used as Reference for Usability Inspection

Usability Heuristics for Touchscreen-based Mobile Devices with Voice-based User Interfaces	
<b>1 Visibility of system status / Suitable feedback</b>	the application should provide feedback to every action of the user; the application should inform the user about successful/not successful recognition of the user's input; the application should keep the user informed about all processes and state changes in a reasonable time; if the application takes a longer processing time, the user should be informed about the current state and also about the expected duration of this waiting time;
<b>2 Match between the system and the real world</b>	the application should speak the user's language with words, phrases and concepts familiar to the user; real-world conventions should be followed, and information should be displayed in a logical and natural order; <u>Voice-based UI</u> : the dialogue structure should resemble human dialogue, and alternative options should be clearly delineated by clear pauses;
<b>3 User control and freedom</b>	the application should allow the user to undo and redo her/his actions, and it should provide "emergency exits" to leave the unwanted state. The user should be allowed to walk through the dialogues in her/his own pace. The user should be able to interrupt at any time, and shouldn't be forced to pass through the extended dialogue. The application should provide a clear way to return to a starting point or main menu.
<b>4 Consistency and standards</b>	the application should follow the established conventions; the user should be able to do things in a familiar, standard and consistent way.

<sup>1</sup> <http://www.nngroup.com/articles/ten-usability-heuristics/>

<sup>2</sup> R. Inostroza, C. Rusu, S. Roncagliolo, C. Jinénez, V. Rusu: "Usability Heuristics for Touchscreen-based Mobile Devices", in 2012 Ninth International Conference on Information Technology – New Generations, IEEE, DOI 10.1109/ITNG.2012.134

<sup>3</sup> V. Farinazzo, M. Salvador, A. L. S. Kawamoto, and J. Soares de Oliveira Neto: "An Empirical Approach for the Evaluation of Voice User Interfaces", in User Interfaces, Rita Matrai (Ed.), 2010, available from: <http://www.intechopen.com/books/user-interfaces/an-empirical-approach-for-the-evaluation-of-voice-user-interfaces>

<sup>4</sup> G. Gaffney, Information & Design Pty Ltd, "Voice Interaction checklist", 2001, [www.infodesign.com.au](http://www.infodesign.com.au)

Usability Heuristics for Touchscreen-based Mobile Devices with Voice-based User Interfaces	
<b>5 Error prevention</b>	in order to prevent errors non-available functionalities should be hidden or disabled, and the user should be able to get additional information about all available functionality. Users should be warned when errors are likely to occur. The application should provide feedback to the user, when the user's input has not been understood, and ask for more information, if the user's input has been ambiguous or inconsistent. The application should use a dialogue strategy based on confirmation;
<b>6 Help users recognise, diagnose, and recover from errors</b>	error messages in the application should be expressed in plain language (no abbreviations, no codes), precisely indicating the problem, and constructively suggesting a solution.
<b>7 Customisation and shortcuts</b>	the application should provide basic configuration options and should give expert users access to advanced configuration options. The application should provide shortcuts to the most frequent tasks and should allow their customization or definition. The application should provide suitable messages that match the level of a variety of users. The application should allow step-by-step actions for novices and more complex inputs for advanced users;
<b>8 Aesthetic and minimalist design</b>	the application should use simple and clear language, and short sentences; the information given should be concise, correct, and relevant
<b>9 Minimise the user's memory load</b>	the user should not have to remember information from one part of the dialogue to another. Objects and options should be visible, and instructions for use should be easily retrievable. <u>Voice-based UI:</u> The application should take into account that users' auditory memory is limited to a few short items; the menu structure should be simple with no unnecessary levels; there should not be more than five options in any menu;
<b>10 Help and documentation</b>	Whenever the user needs it (at any stage of the dialogue), the application should provide easy-to-retrieve instructions and help, centred on the user's current task. A list of concrete steps to carry out should be provided.
<b>11 Interaction and ergonomics</b>	<u>Touch UI:</u> user interface elements should be placed in a recognisable position and should fit the natural posture of the hand. <u>Voice-based UI:</u> the application's outputs should be clear, with natural intonation and rhythm; the application should understand natural user speech, and be tolerant of differences in accent and speech patterns; the application should recognise male, female and child voices equally well; the system should be tolerant of noise;
<b>12 Privacy</b>	information about how personal data is protected and about content's copyright should be given

#### 4.1.2 Summary of the Results of the Usability Inspection

In general the system was appreciated by the experts, even though some HMI related changes (some of which are rather important) should be made to increase the system's usability.

The following positive aspects were noted by the experts:

- The experts appreciated the system for its attempt to implement multimodal voice & manual interaction. Very positive is that the system can use the user's agenda, thus minimizing user's memory load.
- It resembles the social games, widely used on the web via smartphones and tablets. This provides a sort of usability continuity for the driver.
- It is positive that the system suggests an alternative route, so that the user can decide if he/she wants to drive more eco.

On the other hand some usability issues have been underlined by the experts:

- The vocal system has some problems: the English language and the prosody (punctuation, pauses, intonation) do not always help in understanding what the system expects as a user's answer. In addition, the intonation of questions seems poor.
- Another issue that should be solved is the inconsistency: the questions from the system should use the same wording as used on the virtual buttons. Otherwise it is not clear to the user what the user has to answer.
- The system does not understand some easy vocal instruction that a user should use, e.g., "Go to the Map".
- It is not a good solution that the "Push To Talk" button (PTT) must be pressed before each command. The system should automatically switch into "*listening mode*" after each question from the system.
- The general (visual) look and feel of the system is poor.
- In general, the provided textual information is not clear: missing index scale (min and max) and poor formatting (punctuation, spacing, paragraph, font dimension, colours). Moreover, the font-size is too small to be read while driving.
- Spatial organisation of information inside pages should be optimized.

#### 4.1.3 Detailed Documentation of the Findings

The following table lists all positive findings that were observed by the evaluators during the Heuristic Evaluation:

Table 3: Positive Findings of the Experts During Usability Inspection

Description of the Observed Positive Findings	Related Heuristic / Guideline for HMI in the car environment	Reported by Evaluator		
		#1	#2	#3
The system knows the destination from the user's agenda. This can minimize user's memory load and can give the user a positive impression of the system.	9			x
It is positive that the system suggests an alternative route, so that the user can decide if he/she wants to drive more eco.	3	x		
The system knows where I am and is active in suggesting alternative options (details on actual eco-score) without the need to remember that there is this	2, 10	x		

Description of the Observed Positive Findings	Related Heuristic / Guideline for HMI in the car environment	Reported by Evaluator		
		#1	#2	#3
possibility.				
The gamification approach of the Eco Race concept is interesting as it recalls the social games widely used on the web via smartphones and tablets	2		x	
The alternative route is green and this gives the idea that it helps to maximise the eco-score.	3			x
It is a good idea to have voice guidance and speech interaction.	general		x	
Good intent to implement multimodal voice & manual interaction	general		x	

The following table includes all potential usability issues that were revealed by the evaluators. These potential usability problems found in course of the Heuristic Evaluation are ordered according to their severity, with the most critical problems on top of the list.

Table 4: Potential Usability Issues Found by the Experts During Usability Inspection

Description of the Observed Usability Issue	Violated Heuristic / Guideline for HMI in the car environment	Severity	Reported by Evaluator			Corresponding Screenshot(s) (file-name(s))
			#1	#2	#3	
Textual information provided are not clear: index scale (min and max) is missing, formatting of the text is poor (punctuation, spacing, paragraph, font dimension, colours). In addition, the system speaks very fast and makes it difficult to understand the information read.(e.g., vocal information on eco-score)	2, 4, 8, 9	3	x	x	x	see Figure 7
Inconsistence: the questions from the system's voice should use the same wording as used on the virtual buttons. Otherwise it is not clear to the user what he/she has to answer.	4	2.7	x	x	x	
it is not a good solution that the PTT button must be pressed at any command. The system should be put in listening mode automatically after each question from the system.	4, 11	2.7	x	x		
font of the text is too small to be read while driving	1	2.7	x	x	x	
The touch area of the Microphone button is maybe too small since the	11	2.3	x			

Description of the Observed Usability Issue	Violated Heuristic / Guideline for HMI in the car environment	Severity	Reported by Evaluator			Corresponding Screenshot(s) (file-name(s))
			#1	#2	#3	
system often does not respond to the tap						
When reading information (e.g. on eco score), the system is very fast which makes it difficult to understand..	11	2.3			x	
The English language and the prosody do not help in understanding what the system expects as user answer. Also the question's intonation seems poor.	11, 2	2.3	x	x	x	
After a while the map that was shown disappears and the system shows the icon as depicted on the screenshot. This does not give any information to the user	1, 3, 5, 6	2.3	x			see Figure 2
In "trip history", Trip Information, it is not clear what the colours of the paths refer to: last trip? Average traffic in recorded trips?	1	2			x	see Figure 3
The preview of the map: <ul style="list-style-type: none"> <li>- is small and does not give any information about roads the user is going to travel on</li> <li>- could not be zoomed in</li> <li>- is in a north-up orientation and not in a heading-up orientation.</li> </ul>	7, 3, 2	2			x	
It is not clear how to exit or interrupt the interaction. The display should present visually and/or vocally the possible commands, including something like: "Say Back to exit".	10, 3	2	x	x		
Eco score level "as usual" is not a clear information.  The arrow should have a neutral colour.  There is a lot of empty space on the page	4	1.7				see Figure 5
While loading, the system shows an image (see screenshot). However, the animation of this image is poor - it is not continuously "moving" as it should be while loading.	1, 4	1	x			see Figure 4
Buttons' overlapping should be avoided	8, 11	1	x			see Figure 6

### 4.1.3.1 Screenshots Documenting Potential Usability Issues



Figure 2: Screenshot 01



Figure 3: Screenshot 02

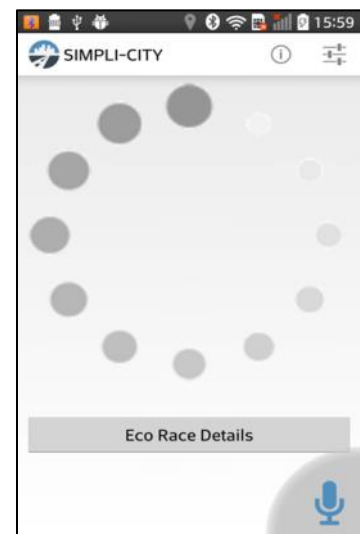


Figure 4: Screenshot 03

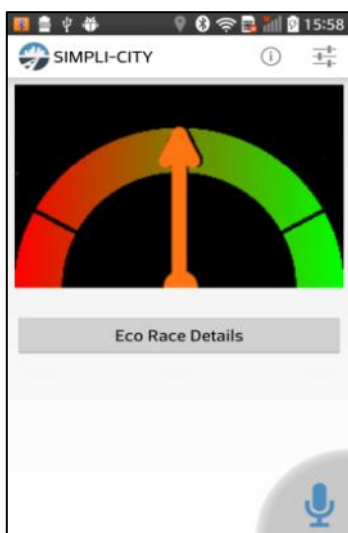


Figure 5: Screenshot 04



Figure 6: Screenshot 05

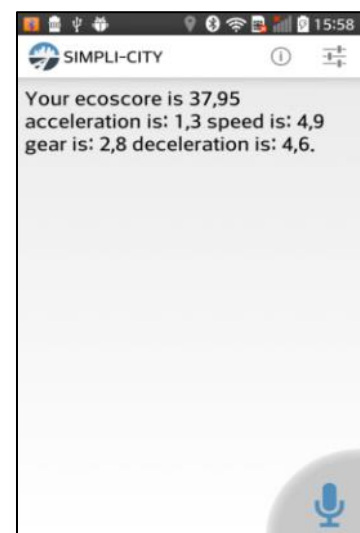


Figure 7: Screenshot 06

## 4.2 Usability Evaluation of the Use Case II.1 related App

This chapter presents the results of the Usability Evaluation of the “Eco Assistant” App from novice users’ point of view.

In Section 4.2.1 the Usability Evaluation approach is described briefly. Section 4.2.2 gives a summary of the results of the Usability Evaluation, and Section 4.2.3 outlines the findings in detail.

## 4.2.1 Approach taken for the Usability Evaluation

### 4.2.1.1 Aim of the Usability Evaluation

This Usability Evaluation was done in order to find the main usability problems novice users encounter while trying the “Eco Assistant” app. It was a first impact usability evaluation both on the vocal and the graphic/touch interface.

The results of this Usability Evaluation give valuable hints for further improvement of the SIMPLI-CITY system.

### 4.2.1.2 Method Applied

For the Usability Evaluation of the “Eco Assistant” application, the well-established Usability Evaluation method “*Thinking Aloud Test*” was applied:

A test-user is asked to speak out loud all her/his thoughts while using the system to complete a given test-task. By observing the test-user’s way of working on the task and by analysing the reasons for confusion, hesitation, or mistakes of the test-user, valuable hints for improvement of the usability of the system can be obtained.

### 4.2.1.3 Team of Facilitators

Four persons from CRF formed the team, which organised and conducted the usability evaluation sessions.

Table 5: Team of Facilitators of the Usability Evaluation Sessions

Name (Organisation)	Role within the Facilitators’ Team
Antonella Masala (CRF)	Co-designer of testing session “Moderator” (guided the test-users through the session and took notes of revealed usability issues)
Mirella Soldati (CRF)	Designer of testing session
Marina Giordanino (CRF)	Camera operator and technical support
Paolo Bande (CRF)	“Technician” (ensured proper functioning of the technical equipment and software)

### 4.2.1.4 Usability Evaluation Sessions

The Usability Evaluation Sessions took place in Centro Ricerche Fiat, Orbassano, Italy.

A vehicle Laboratory hosted the FIAT 500L inside which the testing was held. It was chosen to conduct the usability evaluation session inside a real car in order to increase the naturalness feeling of novice users interacting with the system.



Figure 8: Test Setting for the Usability Evaluation of the “Eco Assistant” App

In total, 8 usability evaluation sessions with test-users were conducted: 4 for evaluation of the English version of the App and further 4 for the Italian version of the App. The pre-test was done on Tuesday, 08.09.2015, and 1 usability evaluation session was conducted on Wednesday, 09.09.2015. Further 4 usability evaluation sessions were hold on Thursday 10.09.2015 and the last 3 sessions on Friday 10.09.2015. The average duration of the usability evaluation sessions was 55 minutes, with the longest session lasting for 80 minutes and the shortest session taking 40 minutes.

All Usability Evaluation Sessions followed the same process:

First the moderator welcomed the test-user, introduced the team and explained the purpose of the session. The moderator gave an overview of the test procedure and asked the test-user for her/his permission that the session can be recorded with focus on hands (video, audio and screen recording), and these records can be used for later analysis and reporting purposes. After the test-user signed the consent form, the moderator encouraged the test-user to ask questions whenever anything is unclear. In a short introductory interview, the moderator obtained from the test-user some demographic information (gender and age) and some information regarding relevant skills and knowledge of the test-user, such as e.g., familiarity with smartphones, Android and expertise with Thinking Aloud tests.

After this introductory part, the test could begin, divided into two sessions:

1. Test setting one: Thinking aloud session focused on graphical/touch user interface (GUI) evaluation
2. Test setting two: voice based user interface (VUI) evaluation through vocal user commands

More in detail:

#### 1. *Test setting one*

The moderator explained to the test-user how the “Thinking Aloud” method works, and asked the test-user to do one test-task after the other and answer the Single Ease Question (SEQ) immediately after completion of each task. While the test-

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 20 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

user was working on the task, she/he spoke out loud all her/his thoughts and considerations, the moderator/observer watched the test-user silently, and took notes of the test-user's activities and any usability issues that became apparent.

Half of the test-user group evaluated the Italian GUI , while the other half evaluated the English GUI .

## 2. *Test setting two*

The moderator showed one by one the tasks to be performed, asking participants to interact with the system through vocal commands. As in test setting one, the moderator/observer watched the test-user silently and took notes of the test-user's activities and any usability issues that became apparent.

Half of the test-user group evaluated the Italian VUI, while the other half evaluated the English VUI.

For both test settings, the moderator/observer used a predefined structured template to simplify data collection.

After finishing the last test-task, the moderator thanked the test-user for her/his cooperation and asked the following three questions in the debriefing interview: "How was it?"; "Was there anything that you found to be especially good?"; "Was there anything that you found to be especially bad?" When the test-user finished answering these questions, the moderator asked her/him to fill-in the System Usability Scale (SUS), a standardised questionnaire to assess a user's perception of the overall usability of a system. In case the test-user had further questions, these were answered by the team and after that the session was finished.

After each session, the moderator/observer took a time to control her notes and organize them as memory of the just-ended trial was vivid. Furthermore, the recordings were saved, and the materials and setup was prepared for the next session.

### 4.2.1.5 Test-Users

In total 8 test-users participated in the Usability Evaluation of the "Eco Assistant" application. All of them answered the introductory questionnaire, did the 4 test-tasks and provided their feedback in the debriefing interview and feedback questionnaire. However, the evaluation session with the first test-user was handled as pre-test and after this session the material, specifically the task descriptions and the introductory questionnaire, were slightly modified according to the lessons learnt from this pre-test.

All 8 test-users were working in CRF (3 apprentices, 5 employees). All of them were between 20 and 50 years old, 3 women and 5 men.

Table 6 gives an overview of the relevant skills and knowledge of the test-users as stated by them in the introduction questionnaire.

Table 6: Overview of the Test-Users' relevant Skills and Knowledge

Test-User	User 1	User 2	User 3	User 4	User 5	User 6	User 7	User 8
Usability Eval. Session	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8
Gender	F	F	M	F	M	M	M	M
Age	20-30	31-40	20-30	41-50	41-50	41-50	20-30	20-30
Peculiarities	NO	Glasses / contact lenses	Glasses / contact lenses	NO	NO	Glasses / contact lenses	Glasses / contact lenses	NO
Mobile phone ownership	Other smart-phone	Other smart-phone	Android smart-phone	Android smart-phone	Android smart-phone	Other smart-phone	Android smart-phone	Other smart-phone
Smartphone usage since	> 1 year	> 1 year	> 1 year	< 6 months	> 1 year	> 1 year	> 1 year	> 1 year
Smartphone user expertise	High	Medium	Medium	Medium	High	High	Medium	Medium
Android user expertise	Medium	NO	High	Medium	High	Medium	High	LOW
Usage of Apps	High	Medium	Medium	Medium	High	High	Medium	High
Usage of voice commands	Medium	Seldom	Seldom	Seldom	Medium	Seldom	Seldom	NO
Car driving expertise	Medium	High	High	High	High	High	High	High
Use smartphone in the car	Medium	Seldom	Seldom	NO	Medium	Medium	Seldom	Medium
Experience with routing / navigation apps	YES	YES	YES	YES	YES	YES	YES	YES
What do you know about SIMPLI-CITY?	Nothing	Nothing	Nothing	Nothing	Nothing	Nothing	Nothing	Nothing
Ever participated in a Usability study?	NO	NO	YES	YES	NO	YES	NO	NO

None of the test-users was involved in the development of the “Eco Assistant” application, and they did not know anything about SIMPLI-CITY.

#### 4.2.1.6 Evaluation Tasks

The test-users were asked to complete the following tasks:

- Task 0: Try and find inside the App the settings to control sound notifications
- Task 1: Show your next trip using car position and information from your agenda
- Task 2: Find an alternative route that allows to maximise your eco-score
- Task 3: Improve your eco-score along your commuting route
- Task 4: Browse your trip history

Annex A of this document, includes the task-sheets, which the test-users got during the usability evaluation session.

## 4.2.2 Results of the Usability Evaluation

The usability evaluation demonstrated a good level of interest from test users in ecological and economical features.

### *Test Setting 1 (Touch Interaction):*

The majority of users (see Section 4.2.3 for details) were able to complete the tasks during Test-Setting 1 (touch interaction). Nevertheless during the test some usability issues became apparent.

The first issue is related to the labels of the main menu of the app, composed by 2 main sections: “Eco-live support” and “Trip history”. Users were often unable to understand that the first menu item is related to the next trip they are about to start.

Issues related to menu structure and information architecture: users often had too many steps to click through before they could reach the required information (e.g. eco-race details). Moreover, having a lot of menu levels creates a loss of awareness of the whole system.

In order to improve the usability of the app, whenever possible, complementary information should be aggregated on the same page (e.g. Map and Trip Information, Eco-race level and Eco race details); moreover breadcrumbs (or a different page layout as *tab navigation* and *harmonium menus*) would help users in their navigation.

Another source of confusion for the users was the fact that the App used familiar graphical elements (e.g. Map) but the interaction with these elements was different from the familiar interaction with the original model. A meaningful example of that is the Map representation with a path: users tried to tap and pinch in/out on it, and moreover they frequently search for a “go” button. What creates doubts and confusion on users is that the system uses classical navigation models without being a navigator. A way to avoid these problems could be to integrate these features on a navigator (as suggested from some users during the debriefing interview) or using a less cluttered and detailed map.

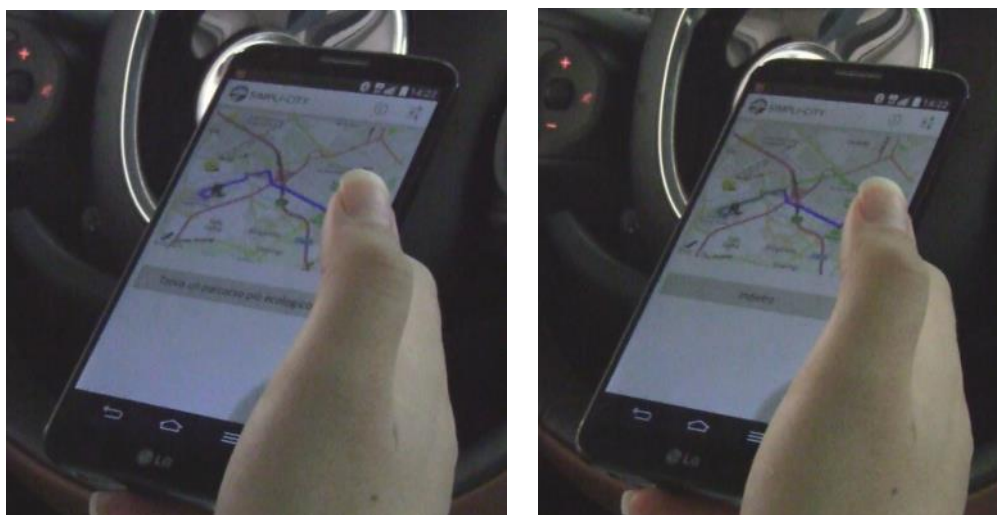


Figure 9: Map and Eco Alternative Path

During task 2, users had difficulties to distinguish and comprehend the more ecological path suggested by the system (“But why this is a more eco path?”).

In task 3, users did appreciate the idea of having an Eco-race feature. Also the meaning of the Eco gauge image (see Figure 10) was clear for the users but they often missed a “guide” that helps them improving their eco driving behaviour (“But it does not tell me how to improve my score!”). Eco race details’ information page (as well as Trip Information page) could be improved in several ways in order to give information at a glance: preferring colours, scales and icon instead of plain text in order to give an idea of the measurements, the rating of the achieved score and the potential for improvement. Also, users would appreciate receiving tips about economic aspects in a playful style (e.g. *Do you know that turning off the air conditioner helps you saving fuel?*).

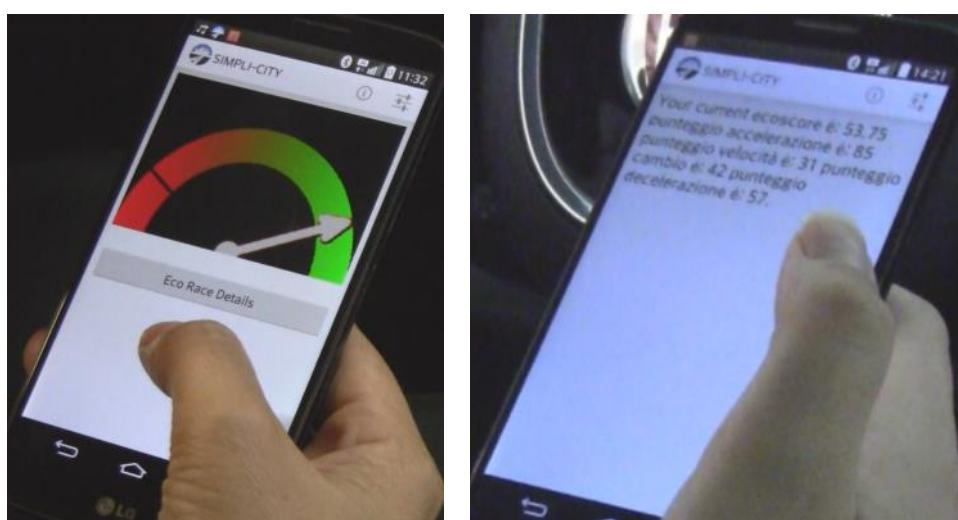


Figure 10: Eco Gauge and Eco Race Details

In general, users appreciated the minimalist graphical style of the app, especially thinking of a usage while driving. However, the design could be improvement with the use of bigger buttons and larger font dimension.

### *Test Setting 2 (Voice-based Interaction):*

The usability issues revealed in test setting 1 also appeared in test setting 2. However, in test setting 2 the main usability issues were related to the vocal system: in fact in most cases the users failed completing the task because of speech input recognition problems.

Sometimes the system did recognise the user's input correctly but couldn't process it (e.g. User's voice input: "Trip History"; system's response: "You said Trip History, I do not understand"). These problems frustrated the users, and increased the task's duration.

Further difficulties encountered are related to:

- Intonation and fluency on the system's voice
- Redundant repetition
- Necessity to press each time the PTT button: the system should stay on "listening mode" as on common voice recognition systems
- Necessity of commands different from button's label

Some users stated that, once familiar with the system's information structure, it should be possible to ask the system specific information from every level of the App (e.g. from the Home Page: "What's my actual Eco score?")

Since users were asked to imagine that (in a final version of the system) the PTT button would be integrated on the steering wheel, usability issues related to that aspect were not taken into account.

The usability issues stated above were observed both for the Italian and the English version of the App (GUI and VUI).

## **4.2.3 Detailed Documentation of the Findings**

### **4.2.3.1 Usability Metrics**

#### **4.2.3.1.1 Task Completion Success Rate**

The task completion success rate score is the number of participants that finished the task successfully divided by the total number of participants.

In test setting 1 (GUI) participants had some difficulties with the tasks, but mostly they managed to resolve these problems on their own. While in test setting 2 (VUI), although the test-users were familiar with the App functionalities, they failed in most cases because of problems with the vocal system.

Table 7: Task Completion Success Rate

Participant	Software version	Task 1		Task 2		Task 3		Task 4	
		GUI	VUI	GUI	VUI	GUI	VUI	GUI	VUI
User 1	Italian	-	-	-	-	✓	-	✓	-
User 2	English	-	-	✓	-	✓	-	✓	-
User 3	English	✓	-	✓	-	-	-	-	-
User 4	English	✓	-	✓	-	✓	-	✓	-
User 5	English	✓	✓	✓	-	✓	-	-	-
User 6	Italian	-	-	-	-	-	-	✓	-
User 7	Italian	✓	✓	✓	✓	✓	✓	✓	-
User 8	Italian	✓	✓	✓	✓	✓	-	✓	-
<b>Success Rate</b>		<b>62%</b>	<b>37%</b>	<b>75%</b>	<b>25%</b>	<b>75%</b>	<b>12%</b>	<b>75%</b>	<b>0%</b>

✓ = successfully completed;

- = not completed / help needed for completion

#### 4.2.3.1.2 Ease-of-Task Ratings

After each task, the participants rated the ease of completing the task, by answering the “Single Ease Question” (SEQ)<sup>5</sup> “Overall this task was?” on a 7-point rating scale ranging from “Very Difficult”(1) to “Very Easy”(7).

Table 8 shows the ratings given to the single tasks by the test-users, and provides an average of these ratings for each task.

Table 8: Ease-of-Task Ratings

Participant	Software version	Task 1		Task 2		Task 3		Task 4	
		GUI	VUI	GUI	VUI	GUI	VUI	GUI	VUI
User 1	Italian	7	7	3	7	7	7	7	7
User 2	English	7	4	6	4	2	5	6	7
User 3	English	7	2	5	1	6	1	6	2
User 4	English	7	6	5	4	4	6	5	5
User 5	English	6	5	7	4	5	5	6	4
User 6	Italian	5	4	2	2	4	4	5	4
User 7	Italian	7	7	2	7	1	1	5	4
User 8	Italian	7	7	5	6	2	2	6	5
Average Rating		6.6	5.2	4.3	4.3	3.8	4	5.7	5

Task 1 was perceived by the users as the easiest one while Task 3 and Task 2 were perceived as the most difficult ones. Apart from a few exceptions, a user’s evaluation of the ease of the task in the different modalities (GUI and VUI) was usually quite similar. These are of course qualitative indications, since the sample size (N = 8) does not give the possibility to apply deeper statistical analysis.

<sup>5</sup> Jeff Sauro: “10 Things to know about the Single Ease Question (SEQ)”, online at <https://www.measuringu.com/blog/seq10.php>, visited 12.06.2015

#### 4.2.3.1.3 Time on Task (TOT)

The amount of time needed by each participant to finish the tasks varied with the graphical and vocal interface. In general, the completion of tasks with the vocal interface was affected by some system issues.

Table 9: Participants' Time-On-Task

Participant	Task 1		Task 2		Task 3		Task 4	
	GUI	VUI	GUI	VUI	GUI	VUI	GUI	VUI
User 1	01:25	02:07	-	01:05	02:25	00:37	01:05	01:34
User 2	00:30	01:43	01:52	01:02	-	02:23	00:52	02:01
User 3	00:30	01:16	02:00	01:49	00:59	-	01:04	01:20
User 4	00:16	01:10	-	02:20	01:00	01:22	00:56	02:14
User 5	00:16	01:37	00:18	02:39	01:44	01:02	01:18	02:04
User 6	00:30	00:54	00:54	00:55	00:43	00:30	00:36	01:29
User 7	00:18	00:36	01:41	01:04	00:44	01:05	00:52	02:20
User 8	01:02	00:32	00:44	02:04	02:31	03:08	01:31	00:32
<b>Average TOT (minutes)</b>	<b>00:36</b>	<b>01:14</b>	<b>01:15</b>	<b>01:37</b>	<b>01:27</b>	<b>01:27</b>	<b>01:02</b>	<b>01:42</b>

#### 4.2.3.1.4 Rating of the Overall System-Usability

After the completion of all tasks, participants were asked to fill in a standardised feedback questionnaire (SUS System Usability Scale), answering the following 10 questions on a 5-point scale ranging from “strongly disagree” to “strongly agree”:

1. I think that I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. I thought the system was easy to use.
4. I would need the support of an experienced person to be able to use this system.
5. I found the various functions in this system were well integrated.
6. I thought there was too much inconsistency in this system.
7. I would imagine that most users would learn to use this system very quickly.
8. I found the system very cumbersome to use.
9. I felt very confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

SUS yields a single number<sup>6</sup> representing a composite measure of the overall usability of the system. SUS scores have a range of 0 (“not usable at all”) to 100 (“perfectly usable system”).

<sup>6</sup> According to John Brooke „SUS – A quick and dirty usability scale”

(<http://hell.meiert.org/core/pdf/sus.pdf/>) :

“To calculate the SUS score, first sum the score contributions from each item. Each item’s score contribution will range from 0 to 4. For items 1,3,5,7, and 9 the score contribution is the scale position minus 1. For items 2,4,6,8 and 10 the contribution is 5 minus the scale position. Multiply the sum of the scores by 2.5 to obtain the overall value of the SUS score. SUS scores have a range of 0 to 100.”

Analysis of the answers of the test-users to the feedback questionnaire reveals that the “Eco Assistant” application has a SUS score of 57.5. According to Bangor A. et al<sup>7</sup>, this SUS score can be translated to users’ perceiving that the usability of the system is “o.k.” This is quite good for a prototype system, but indicates that there is still some improvement of the system’s usability necessary.

#### 4.2.3.2 Main Positive Aspects Mentioned by the Test-Users

##### 1. The idea of eco functions

User 1: *“I liked the idea of finding an alternative Eco route.”*

User 2: *“...I like the idea of show me eco indications in order to improve my score”*

User 3: *“The alternative path, when the App shows you an eco-path within your exact destination, how long it will be, it is very precise”*

User 4: *“The calculation of the most eco route is interesting, it will be nice to know the way the system calculates it. It can also be interesting the idea to improve your score, but it needs a more graphical interface”*

##### 2. No-Frills

User 6: *“It was quite essential, without distracting elements”*

User 8: *“I appreciate that it is very easy, considering that you have to use it in your car, but it seems to me that it does not give me any function”*

#### 4.2.3.3 Main Usability Issues Revealed During the Evaluation

##### Main GUI Usability Issues Mentioned by the Test-Users

Users were asked an overall evaluation at the end of the 1<sup>st</sup> test session when they completed tasks using the graphical interface of the app:

##### 1. Comprehension of the system/features

User 1: *“It is not very clear to me the scope of this app, I guess it does not work with a not frequent journey”*

User 3: *“Sometimes you are not so confident taking a decision, you need to explore it more”*

User 5: *“It took a bit to understand how information is structured: what refers to future and what is history info”*

User 6: *“Sometimes I did not understand...there are too many levels to complete the requested task”*

##### 2. Information

User 2: *“Sometimes information is not complete, moreover the information screen would be more interactive than a text”*

<sup>7</sup> Adjective ratings related to SUS scores: 25 = “worst imaginable”, 38 = “poor”, 52 = “acceptable / o.k.”, 74 = “good”, 85 = “Excellent”, 100 = “best imaginable” (Source: Bangor A., Kortum P., Miller J.: “Determining What Individual SUS Scores Mean: Adding an Adjective Rating Scale”, in Journal of Usability Studies JUS, Vol. 4, Issue 3, May 2009, pp. 114-123)

User 8: *"I think that the screen with the map should be more rich of information, moreover the information is all on the same text line. Since you should use the App while you are driving, information should be more visible immediate at a glance"*

### 3. Graphical aspects

User 8 *"There is too much empty space, space is not well occupied"*

#### **Main VUI Usability Issues Mentioned by the Test-Users**

In test-setting 2, when interacting with the App via the vocal system, the test-users were asked for a comment after the completion of each test-task:

User 3: *"At the beginning it was ok, but I cannot terminate the task"*

User 4: *"It does not understand me and even if it understands "Trip History" it does not go ahead"*

User 5: *"I would not press the button every time"*

User 7: *"It needs too much attention; I think it would distract me too much in a real context"*

#### **Main Overall Usability Issues Mentioned by the Test-Users**

During the debriefing interview at the end of the Usability Evaluation Sessions, the test-users mentioned several aspects of the SIMPLI-CITY system, which should be improved:

User 1: *"I've some problems with the first page because you have to enter Eco Live support instead of Trip History"*

User 5: *"It's interesting that it gives you an alternative eco route, it can also be interesting to understand how actually it calculates it. It can also be interesting the feature of improving your score but it needs a more graphical interface"; "There are too many levels"*

User 8 *"It seems to me that it does not give me enough information. Even if it is simple and you can go back quickly, my feeling was of confusion."*

User 7 *"I feel not guided"*

## **4.3 Functional Evaluation of the Use Case II.1 related App**

This chapter presents the results of the Functional Evaluation of the "Eco Assistant" application that covers the Use Case Topic II.1 "Environmental Awareness Rising".

In Section 4.3.1 the Functional Evaluation approach is described briefly, and Section 4.3.2 gives a summary of the results of the Functional Evaluation.

### **4.3.1 Approach taken for the Usability Evaluation**

The Functional Evaluation aimed to validate that the SIMPLI-CITY system functions under real-world conditions.

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 30 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

#### 4.3.1.1 Applied Methods for the Functional Evaluation

For each of the scenarios implemented, some test cases derived from the Functional Specification were defined and executed in a real car in real traffic in order to demonstrate the coverage of the requirements for each scenario.

Findings from the Functional Evaluation were summarized, and, in addition, the usage of the application in a real car in real traffic was also documented by video and pictures.

#### 4.3.1.2 Actors Involved in the Functional Evaluation

Functional Evaluation of the Use Case II.1 related App “Eco Assistant” was performed by CRF in Turin. Two persons formed the team and conducted the evaluation:

- The first with the role of test user, drove the vehicle testing the App functionality
- The second was the observer that asked the test-user to perform the defined test cases and took notes of the results

#### 4.3.1.3 Equipment

For the functional evaluation the SIMPLI-CITY show car (a FIAT 500 L Trekking) equipped as illustrated in deliverable D8.2 was used.

The OBU sensor feeder, which sends car signals collected from the CAN bus to the CRF Car Sensor that is part of the PMA sensors, was installed on the OBU. The OBU sensor feeder and the CRF Car Sensor were developed by CRF; a detailed description is provided in deliverable D4.3.2.

The smartphone, a Nexus 5 with Android 4.4.2, was connected to the vehicle via Bluetooth for receiving car data through the OBU and for reproducing audio outputs of the App through the car speakers.

On the smartphone the SIMPLI-CITY Apps (including the “Eco Assistant” App) and the PMA sensors were installed.

The smartphone was connected via 3G to the backend services deployed on the SIMPLI-CITY SRE and to the MMDI backend for processing the multimodal interaction.

#### 4.3.1.4 Functional Evaluation Session

The Functional Evaluation Session took place in Centro Ricerche Fiat, in Orbassano, Italy during the first week of August 2015.

The test user drove the test vehicle FIAT 500L (equipped as described in Section 4.3.1.3) along the route from CRF to the FCA headquarter in Corso Luigi Settembrini, Turin, Italy, and performed all the defined test cases listed in Section 4.3.1.5.

#### 4.3.1.5 Test Cases

The test cases defined for the Functional Evaluation of the “Eco Assistant” application are listed in Table 10. These test cases were defined keeping into account the main functionalities implemented in the application as described in deliverable D8.2.

Table 10: Test Cases for Functional Evaluation

Test Case Id	Test Case Title	Test Case Description
Test1	Next Trip Information	Show your next trip using car position and information from your agenda (Task to be done before the trip)
Test2	Alternative Eco Route	Find an alternative route that allows to maximise your eco-score (Task to be done before the trip)
Test3	Eco Race	Improve your eco-score along commuting route (Task to be done during the trip)
Test4	Trip History	Browse your trip history (Task to be done before or after the trip)

#### 4.3.1.6 Use case Requirements Relevant for Functional Evaluation

The requirements specified in deliverable D2.3 at the beginning of the project included also some requirements that are specifically relevant for the Use Case II.1 related “Eco Assistant” App.

Table 11: Use Case Requirements Relevant for “Eco Assistant” App

Id	Requirement Description	Priority
U214	Reporting to the end user about eco-driving information	Must Have
U215	Vehicle information available to the system	Must Have
U216	Provision of real time feedback to the user in order to improve his/her performance	Must Have
U217	Access to journey-related eco-driving data using the specific web portal	Should Have
U218	Comparing (eco-)performances of different drivers	Should Have

### 4.3.2 Results of the Functional Evaluation

Table 12 below indicates the relevance of the use case requirements for each test case performed during the Functional Evaluation.

Table 12: Test Cases vs. Use Case Requirements

Test Case		U214	U215	U216	U217	U218
Test 1	Next Trip Information		✓			
Test 2	Alternative Eco Route	✓				(✓)
Test 3	Eco Race	✓		✓		(✓)
Test 4	Trip History	✓			✓	

✓ .... use case requirement is covered by the test case

(✓).. use case requirement is partially covered by the test case

The “Eco Assistant” application offers a set of functionality for improving the eco behaviour that takes into account the ecoscore of a single user. The “Eco Assistant” App covers mainly the requirements U214 – U217. Although the test case “Alternative Eco Route”, which compared the ecoscore related to different routes travelled by a single or multiple users, and the test case “Eco Race”, which compared the ecoscore achieved by a single user for the same route at different times, partially also covered the requirement U218.

### 4.3.3 Performed Test Cases

In the following sections a brief description of each test case, which was performed by the test user using the “Eco Assistant” application installed on the smartphone, is given.

#### 4.3.3.1 Test 1: Next Trip Information

In the vehicle, before starting the trip, the test user visualized the information related to the next trip planned in the agenda as shown in Figure 11. The system used correctly two data sources to retrieve the car position from the car data and the destination from the user’s agenda.

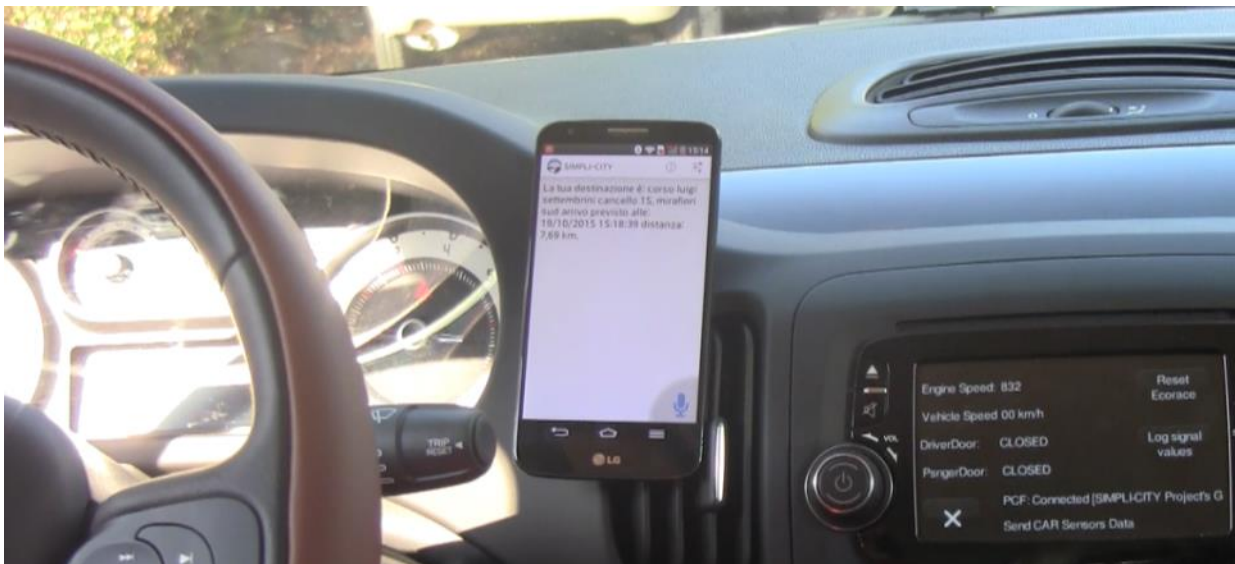


Figure 11: Eco Assistant –Test 1 (Visualisation of Trip Information before Starting the Trip)

#### 4.3.3.2 Test 2: Alternative Eco Route

In the vehicle, before starting the trip, the test user asked the system to show a possible alternative route, which would be more eco than the test user's usual route to the planned destination. The system showed on the screen a map where both the alternative and the usual route to the given destination were visualized. The alternative route was calculated based on the achieved ecoscore stored in the trip history repository.



Figure 12: Eco Assistant – Test 2 (Asking System to Show an Alternative Route)

#### 4.3.3.3 Test 3: Eco Race

In the vehicle, during the trip, the test user visualized the result of the race with himself in real time as shown in Figure 13. At the end of each route portion, the system showed a gauge that highlighted the difference between the ecoscore just achieved for the last portion of the route and the average ecoscore achieved in the past for the same route portion.

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 34 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

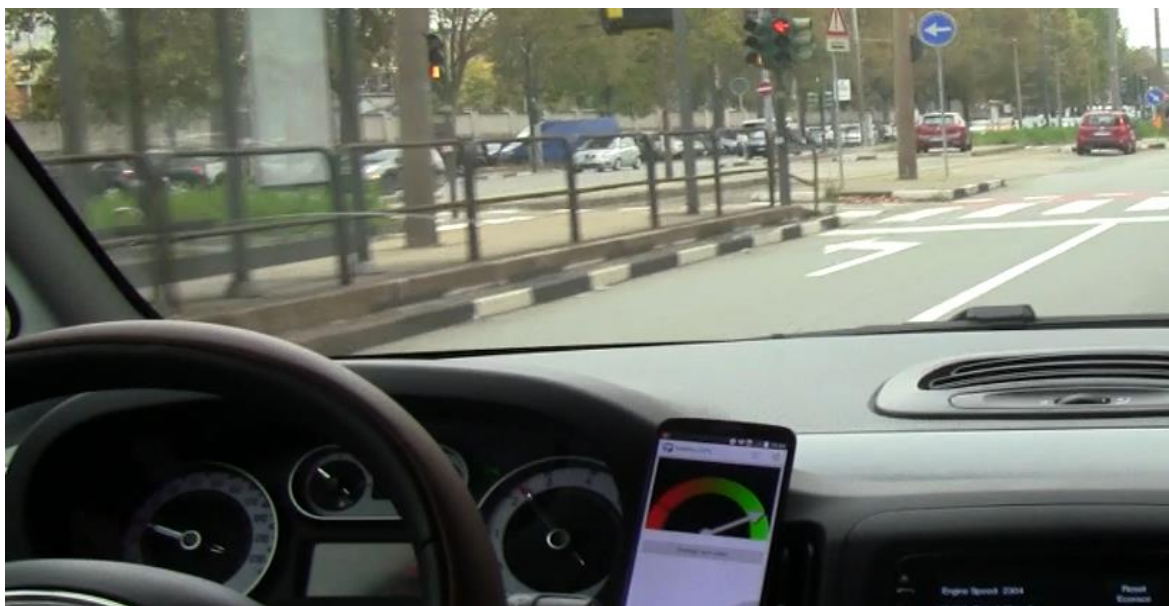


Figure 13: Eco Assistant – Test 3 (Visualising the Eco Results in Real-Time on the Trip)

#### 4.3.3.4 Test 4: Trip History

After the trip, the test user visualized the eco information about his/her historical trips as shown in Figure 14. The system showed information that summarized the eco behaviour of the driver for the usual trips stored in the trip history repository.



Figure 14: Eco Assistant – Test 4 (Visualising Eco Information After the Trip)

#### 4.3.4 Achieved Results

The following tables summarise the results revealed by the Functional Evaluation of the “Eco Assistant” App with respect to the related requirements.

Table 13: Results of the Functional Evaluation

	Requirement Description	Grade of Fulfilment	Explanation
<b>U214</b>	<b>Reporting to the end user about eco-driving information</b>  The apps developed for SIMPLI-CITY should provide information to the end user about the user's eco-driving style in an intuitive and aggregate form. Information about the performance of the vehicle in terms of acceleration, speed, brake, gear shift will be provided to the end user.	completely fulfilled	Both real time and historic information about the achieved ecoscore and related parameters are provided to the user by the “Eco Assistant” App.
<b>U215</b>	<b>Vehicle information available to the system</b>  The vehicle should provide to the SIMPLI-CITY system information about the vehicle's parameters. Information about the total odometer, instantaneous vehicle speed, GPS longitude and latitude should be available to the SIMPLI-CITY system. The vehicle sensor data should be available for the mobility services and user application	completely fulfilled	The “Eco Assistant” App used vehicle position and eco driving parameters to achieve the provided functionalities
<b>U216</b>	<b>Provision of real time feedback to the user in order to improve his/her performance</b>  In order to improve the user experience, the apps developed for SIMPLI-CITY should provide responsive feedbacks. The driver should be able to take fast decision if needed to change route or have real time feedback about the current eco-driving style.	completely fulfilled	The “Eco Assistant” App gives live feedback to the user during a trip comparing the live ecoscore with the average ecoscore achieved in the past for the same route portion and reproducing a comment for stimulating the user to improve his own score
<b>U217</b>	<b>Access to journey-related eco-driving data using the specific web portal</b>  The SIMPLI-CITY system should provide to the end user information about the journey-related eco-driving information using a specific web portal.  This web portal will be published on the Internet and publicly accessible by the driver and the other passengers of the vehicle.  The driver can receive suggestions about his performance on specific route that should be displayed in a map on the specific web page..	completely fulfilled	Information related to historic trip eco-driving data are available with the “Eco Assistant” App choosing the option Trip History

	Requirement Description	Grade of Fulfilment	Explanation
U218	<p><b>Comparing (eco-)performances of different drivers</b></p> <p>The apps developed for SIMPLI-CITY should compare the individual (eco-) performance against the performances of other drivers with comparable parameters, e.g., similar traffic situation, similar cars, and of course similar journeys.</p>	completely fulfilled	<p>A comparison between eco performances of a single user at different times is calculated by the "Eco Assistant" App when choosing the Eco Race option.</p> <p>A comparison between the eco performances of different routes (eventually travelled by different drivers) is given when choosing the Alternative Route option.</p>

## 5 Evaluation of the Use Case II.2 Related App

### 5.1 Usability Inspection of the Use Case II.2 related App

#### 5.1.1 Approach Taken for the Usability Inspection

For Usability Inspection of the Use Case II.2 related App, a slightly different approach was taken than for Usability Inspection of the Use Case II.1 related App: instead of conducting one Usability Inspection with a group of experts at a comparatively mature state of development, for the Use Case II.2 related App it was decided to have more frequent Usability Inspections done by one expert accompanying the development process from an early stage: Starting from July 2015, Usability Inspection was done by an expert from FGM every time when a new release of the Use Case II.2 related SIMPLI-CITY App was available. The Usability Inspection method used was task-based Heuristic Evaluation as described in detail in Section 4.1.1.4. The results of each of these Usability Inspections were communicated to the developers immediately after each inspection, so that the App could be improved accordingly.

Table 14 below gives some general information regarding the expert who did the Usability Inspection, the place where the inspection was conducted, and some relevant technical details about the device used for the Usability Inspection.

Table 14: Usability Inspection(s) of the Use Case II.2 related App - General Information

<b>Evaluator Name / Organisation</b>	Michaela Kargl / FGM
<b>Date(s) of Usability Inspection</b>	July – September 2015
<b>Place of Usability Inspection</b>	Graz
<b>Test-Device Model</b>	Smartphone LG NEXUS 4
<b>Test-Device Operating System</b>	Android 5.1.1
<b>Internet Connection</b>	Wi-Fi
<b>Preferences</b>	Installation of Apps from unknown sources enabled

#### 5.1.2 Usability Issues Found

The usability issues found were mainly related to

- missing system feedback (e.g., the system did not confirm the user's voice input and thus the user did not know whether or not the system had understood her/him)
- inconsistency of the system's visual and auditory output (e.g., for some views the system displayed a list of options to select from, but the system-voice just stated the question and not the possible options for the answer)
- misleading / confusing wording (e.g., some menu titles did not logically correspond to the offered selection options)
- functional problems (e.g., the system did not understand the user's voice input)

The following Table 15 includes a detailed description of all potential usability issues that were revealed by the evaluator in the last Usability Inspection (done on 08.09.2015). These usability problems found in course of the Heuristic Evaluation are ordered according to their severity, with the most critical problems on top of the list. The severity was assessed according to the following scale:

- 1 – Cosmetic problem (is not necessary to be fixed)
- 2 – Medium severe usability problem (should be fixed)
- 3 – High level usability problem (imperative to fix this before product can be released)

Table 15: Usability Issues Found by Heuristic Evaluation

#	Description of the Observed Usability Issue	Violated Heuristics <sup>8</sup>	Severity
1	<b>Usability Issue:</b> There is no help or guidance for the user	10	3
2	Driving Experience -> Map -> Select Route -> Select Origin: Voice: "Select the origin city" Display: Text "Select Route", Buttons: "Select Origin", "Select Destination", "Select Time Interval", "Select Transport", "Show Route" <b>Usability Issue:</b> discrepancy between display and voice output	4	3
3	Driving Experience -> Map -> Select Route -> Select Time Interval Voice: "What hour?" Display: Text "Select Route", Buttons: "Select Origin", "Select Destination", "Select Time Interval", "Select Transport", "Show Route" <b>Usability Issue:</b> discrepancy between display and voice output	4	3
4	Driving Experience -> Map -> Select Route -> Select Time Interval Voice: "What hour?" Display: Text "Select Route", Buttons: "Select Origin", "Select Destination", "Select Time Interval", "Select Transport", "Show Route" <b>Usability Issue:</b> discrepancy between display and voice output	4	3
5	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Start Navigation -> Information of POI -> Touch input: POI multimedia System switches to Display "Start Navigation" and Voice output "Returning to POI multimedia. Do you want to Information of POI or Share location?" <b>Usability Issue:</b> this is confusing! Voice output states "Returning to POI multimedia" but the system switches to a completely different view "Start Navigation"...	4	3
6	Driving Experience -> Map -> Select Route -> Select Time Interval Voice: "What hour?" Display: Text "Select Route", Buttons: "Select Origin", "Select Destination", "Select Time Interval", "Select Transport", "Show Route" Speech input: "Seventeen" Voice: "What minute?" Speech input: "Five" System switches to Display: Text: "You are at: jakomini, keesgasse, 11", Buttons: "Select Route", "Saved Routes"; Voice: "Returning to Map. Do you want to Select Route or Saved Routes" <b>Usability Issue 1:</b> discrepancy between display and voice output <b>Usability Issue 2:</b> missing system feedback (the user does not know, whether the system has understood the speech input "seventeen"...) <b>Usability Issue 3:</b> user does not understand, why the system switches to this menu and does not stay at Display: Text "Select Route", Buttons: "Select Origin", "Select Destination", "Select Time Interval", "Select Transport", "Show Route"...	1, 4	3

<sup>8</sup> refer to Section 4.1.1.5 for details on the utilised List of Heuristics

#	Description of the Observed Usability Issue	Violated Heuristics <sup>8</sup>	Severity
7	Driving Experience -> Map -> Saved Routes Display: Text "What route do you want to select?", Buttons: "Route 1", "Route 2", "Route 3" Voice: "What route do you want to select?" <b>Usability Issue:</b> discrepancy between display and voice output (selection possibilities are not announced by voice output)	1, 4	3
8	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Start Navigation -> Share location -> Facebook Display: Text "Add a comment to facebook?" Voice output: "Do you want to Yes or No?" <b>Usability Issue:</b> discrepancy between display and voice output; The Voice states only the answering options but does not state the question - this is confusing	2, 4	3
10	Driving Experience -> Map -> Select Route -> Select Origin: Voice: "Returning to select origin. Select the origin city" Speech Input: "Vienna" System answers: "I heard you say Vienna, I do not understand. So, select the origin city". Speech Input: "Bologna" System answers: "I heard you say Bologna. I do not understand. So, select the origin city". Speech input: "Dublin" System answers: "So, select the origin city" ... Functional Issue: it seems that the system does not understand the user's speech input <b>Usability Issue:</b> only speech input is possible - thus the user has no chance to proceed, if the system does not understand her/his utterances	3, 11	3
12	Driving Experience -> Map: Display: Text: "You are at: jakomini, keesgasse, 11", Buttons: "Select Route", "Saved Routes" Voice: "Do you want to Select Route or Saved Routes" <b>Usability Issue:</b> voice does not announce the current location; the display and voice output should be consistent	4	2
13	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Change Route Display: Text "Select a route", Buttons: "Alternative Route 1", "Alternative Route 2", "Alternative Route 3" Voice: "Select a route" <b>Usability Issue:</b> discrepancy between display and voice output (selection possibilities are not announced by voice output)	4	2
14	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Select a Point of Interest Display: Text "Select a point of interest", Buttons: "Tourist attractions", "Black spots", "Gas stations" Voice: "Select a point of interest" <b>Usability Issue:</b> discrepancy between display and voice output (selection possibilities are not announced by voice output)	4	2
15	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Start Navigation -> Information of POI -> Go to POI Display: Text "Go to POI", Button: "Confirm" Voice: "Are you sure, do you want to change the destination to POI?" <b>Usability Issue:</b> discrepancy between display and voice output	4	2

#	Description of the Observed Usability Issue	Violated Heuristics <sup>8</sup>	Severity
16	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Start Navigation -> Share location Display: Text "Select a social platform.", Button: "Facebook" Voice: "Do you want to Facebook?" <b>Usability Issue:</b> discrepancy between display and voice output	4	2
17	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Start Navigation -> Share location -> Facebook -> Yes Display: Text "Yes", Button: "Comment_1", "Comment_2" Voice: "Add your comment now" <b>Usability Issue:</b> discrepancy between display and voice output	4	2
18	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Start Navigation -> Information of POI -> Touch input: POI multimedia System switches to Display "Start Navigation" and Voice asks "Do you want to Information of POI or Share location?" <b>Usability Issue:</b> this is confusing! It is not clear for the user, why the system switched to this menu view...	4	2
19	Driving Experience -> Map -> Saved Routes Display: Text "What route do you want to select?", Buttons: "Route 1", "Route 2", "Route 3" Voice: "What route do you want to select?" Speech input: "Route Two" Voice: "I heard you say route two, I do not understand. So, what route do you want to select?" Speech input: "Route Two" Voice: "I did not hear" Speech input: "Route Two" Voice: "I heard you say route two, I do not understand." Speech input: "Route One" Voice: "I heard you say route one. I do not understand." ... <b>Usability Issue:</b> it seems that the system does not understand the user's speech input	11	2
20	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Start Navigation -> Information of POI Display: Text "Information of POI", Buttons: "Go to POI", "Share POI", "Poi multimedia" Voice: "Do you want to Go to POI, Share POI, or Poi multimedia?" Speech input: "Go to POI" Voice: "I heard you say go to play. I do not understand. So, do you want to go to poi, share poi, or poi multimedia?" Speech input: "Go to POI" Voice: "I heard you say go to play. I do not understand. " <b>Usability Issue:</b> it seems that the system does not understand the user's speech input	11	2
21	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Start Navigation -> Information of POI -> Go to POI Display: Text "Go to POI", Button: "Confirm" Voice: "Are you sure, do you want to change the destination to POI?" Speech input: "Yes" Voice output: "Are you sure, do you want to change the destination to POI?" Speech input: "Yes" Voice output: "Are you sure, do you want to change the destination to POI?" Speech input: "Confirm" Voice output: "I heard you say concern, I do not understand." ... <b>Usability Issue:</b> it seems that the system does not understand the user's speech input	11	2

#	Description of the Observed Usability Issue	Violated Heuristics <sup>8</sup>	Severity
22	<p>Driving Experience -&gt; Map -&gt; Saved Routes -&gt; Touch Input: Route 1 -&gt; Start Navigation -&gt; Share location -&gt; Facebook -&gt; Yes  Display: Text "Yes", Button: "Comment_1", "Comment_2"  Voice: "Add your comment now"  Speech input: "Comment one"  Voice output: "I heard you say comment one. I do not understand. So, add your comment now"  Speech input: "Hello"  Voice output: "I heard you say hello. I do not understand"  Speech input: "Comment two"  Voice output: "I heard you say comment two. I do not understand."  Speech input: "Add comment"  Voice output: "I heard you say add comment. I do not understand"  Speech input: "Add comment one"  Voice output: "I heard you say add comment one. I do not understand"...</p> <p><b>Usability Issue:</b> it seems that the system does not understand the user's speech input</p>	11	2
23	<p>Driving Experience -&gt; Map -&gt; Saved Routes -&gt; Touch Input: Route 1 -&gt; Start Navigation -&gt; Information of POI  Display: Text "Information of POI", Buttons: "Go to POI", "Share POI", "Poi multimedia"  Voice: "Do you want to Go to POI, Share POI, or Poi multimedia?"  Speech input: "Poi multimedia"  Voice output: "I heard you say almighty media. I do not understand. So, do you want to go to poi, share poi, or poi multimedia?"  Speech input: "Poi multimedia"  Voice output: "I heard you say toiletamedia. I do not understand. "...</p> <p><b>Usability Issue:</b> it seems that the system does not understand the user's speech input</p>	11	2
24	<p>Driving Experience -&gt; Map -&gt; Saved Routes -&gt; Touch Input: Route 1 -&gt; Change Route  Display: Text "Select a route", Buttons: "Alternative Route 1", "Alternative Route 2", "Alternative Route 3"  Voice: "Select a route"  Speech input: "Route one"  Voice: "I heard you say route one. I do not understand. So, select a route."  Speech input: "Route three"  Voice: "I heard you say route three. I do not understand. So, select a route."...</p> <p><b>Usability Issue:</b> it seems that the system does not understand the user's speech input; It is not clear for the user, what she/he is expected to say to the system</p>	11, 2	2
25	<p>Driving Experience -&gt; Map -&gt; Saved Routes -&gt; Touch Input: Route 1  Display and Voice: "Route set to Route 1"  System switches to new view:  Display: Text "Show Route", Buttons: "Start Navigation", "Change Route", "Select a Point of Interest", "Save Route"  Voice: "Do you want to Start Navigation, Change Route, Select a Point of Interest, or Save Route?"</p> <p><b>Usability Issue:</b> "Show route" is a confusing title for this menu, since it seems not possible to ask the system to show the route...</p>	2, 4	2

#	Description of the Observed Usability Issue	Violated Heuristics <sup>8</sup>	Severity
26	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Start Navigation Display: Text "Start Navigation", Buttons: "Information of POI", "Share location" Voice: "Do you want to Information of POI or Share location?" <b>Usability Issue:</b> "Start navigation" is a confusing title for this menu, since in this menu there is no option to start the navigation	2, 4	2
27	Driving Experience -> Map -> Saved Routes -> Touch Input: Route 1 -> Start Navigation -> Information of POI Display: Text "Information of POI", Buttons: "Go to POI", "Share POI", "Poi multimedia" Voice: "Do you want to Go to POI, Share POI, or Poi multimedia?" <b>Usability Issue:</b> "Information of POI" is a confusing title for this menu, since it seems to provide not only information regarding the POI ("POI multimedia") but there's also the option to navigate to the POI ("go to POI"), or to share (information of?) the POI with social networks ("Share POI"); In addition, all these options do not really make sense, since the user has only selected a category of POIs (black spots, tourist attractions, or gas stations) but has not chosen a specific POI from the selected category, yet...	2, 4	2

In addition to these detailed descriptions of the revealed usability problems, also a video was recorded during the Usability Inspection to illustrate the problems. This video was sent to the developers together with the list of revealed usability issues in order to explain the usability issues more clearly and thus facilitate the developers' work with improving the App. The following figure shows some screenshots of the video.

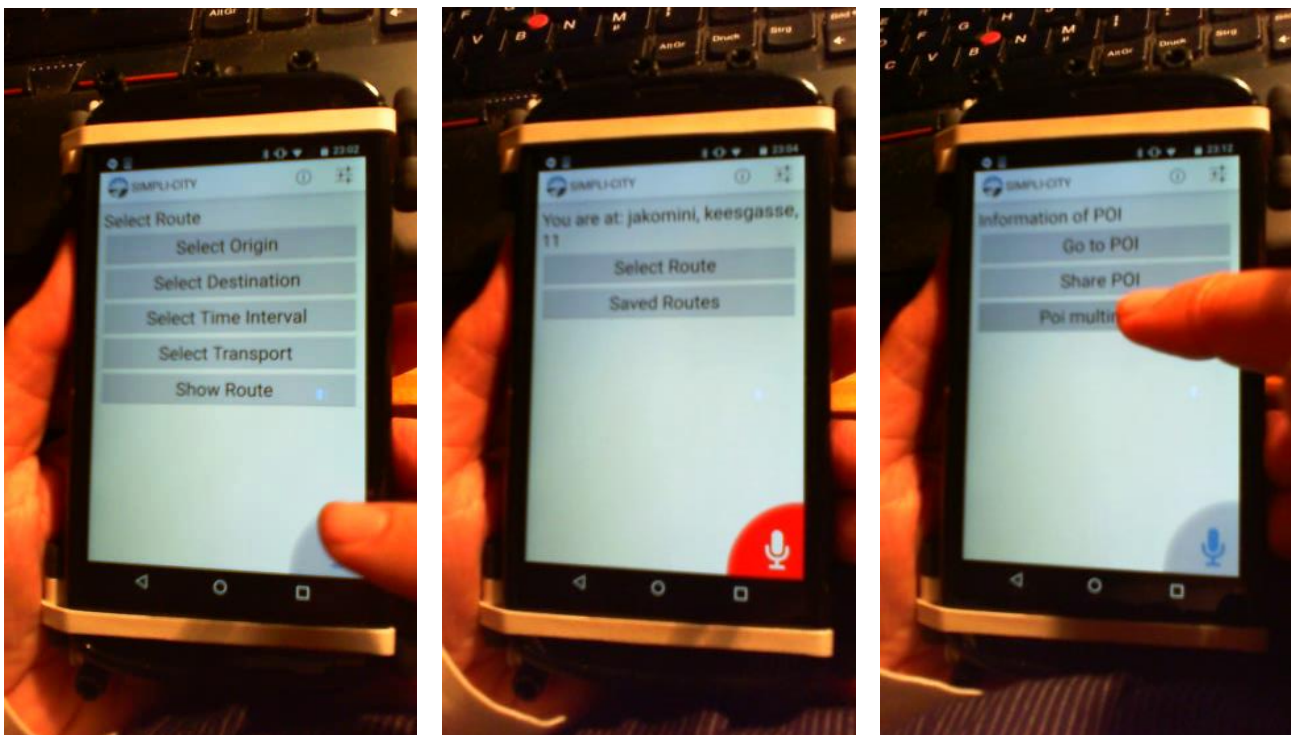


Figure 15: Example Screenshots from Video Recorded during Usability Inspection

## 5.2 Usability Evaluation of the Use Case II.2 related App

This chapter presents the results of the Usability Evaluation of the Use Case II.2 related SIMPLI-CITY App from road-users' perspective.

In Section 5.2.1 the Usability Evaluation approach is described briefly. Section 5.2.2 gives a summary of the results of the Usability Evaluation, and Section 5.2.3 outlines the findings in detail.

### 5.2.1 Approach Taken for the Usability Evaluation

This Usability Evaluation was done in order to find out the main usability problems, which novice users encounter while trying the "Driving Experience" app. It was a usability evaluation both on the visual/touch interface and on the voice-based interface.

The results of this Usability Evaluation give valuable hints for further improvement of the SIMPLI-CITY system.

For the Usability Evaluation of the "Increased Mobility" app, the well-established Usability Evaluation method "*Thinking Aloud Test*" was applied. This method is described in detail in Section 4.2.1.2 of this document.

#### 5.2.1.1 Facilitators' Team

Three persons from FGM formed the team, which organised and conducted the usability evaluation sessions.

Table 16: Team of Facilitators of the Usability Evaluation Sessions

Name (Organisation)	Role within the Facilitators' Team
Michaela Kargl (FGM)	"Moderator" (guided the test-users through the session)
Markus Schuster (FGM)	"Observer" (took notes of revealed usability issues)
Andreas Maurer (FGM)	"Technician" (ensured proper functioning of the technical equipment and software)

#### 5.2.1.2 Test-Users

In total 4 test-users participated in the Usability Evaluation of the "Driving Experience" app. All of them answered the introductory questionnaire, did the test-tasks, and provided their feedback in the debriefing interview and feedback questionnaire.

Table 17 gives an overview of the relevant skills and knowledge of the test-users as stated by them in the introduction questionnaire.

Table 17: Overview of the Test-Users' Relevant Skills and Knowledge

Test-user	Volker	Herbert	Maria	Merlin
Usability Evaluation Session	Session 1	Session 2	Session 3	Session 4
Gender	male	male	female	female
Age	31-40	31-40	31-40	41-50
Peculiarities	-	Glasses / contact lenses	Glasses / contact lenses	-
Mobile phone ownership	iOS	Android	Android	iOS
Smartphone usage since	> 1 year	> 1 year	> 1 year	> 1 year
Smartphone user expertise	high	medium	low	medium
Usage of Apps	high/a lot	high/a lot	seldom	medium
Usage of voice commands	seldom	seldom	no	no
Car driving expertise	high	medium	medium	no
Use smartphone in the car (as driver)	medium	medium	seldom	no
Experience with routing apps	Google Maps	Google Maps, Osmand	Google Maps	Google Maps
What do you know about SIMPLI-CITY?	heard of	heard of	heard of	heard of
Ever participated in a Usability study?	yes (thinking aloud test)	no	no	no

### 5.2.1.3 Usability Evaluation Sessions

The Usability Evaluation of the “Driving Experience” App took place in a car parked in front of FGM's office in Graz, Austria, on 17.09.2015.

The test-user took the driver's seat, and the moderator sat beside the test-user in the front seat (see Figure 16). The observer and the technician took the seats in the back of the car.



Figure 16: Usability Evaluation was done in a Parked Car

All usability evaluation sessions were recorded with two cameras, as depicted in Figure 17:

An action cam (Qumux HD) mounted on top of the dashboard was used to record the whole scene, including the test-user's facial expressions and voice. A webcam (Microsoft LifeCam HD-3000) mounted on a rig, which held also the Smartphone, was used to capture the Smartphone's screen and the test-user's fingers interacting with the Smartphone. The webcam was connected to a laptop computer running the LifeCam Software for recording of the video. This laptop was placed on the backseat of the car, right beside the technician and the observer.



Figure 17: Two Cameras were used for Recording of the Usability Evaluation Sessions

In total 4 sessions for the Usability Evaluation of the “Driving Experience” App were conducted. The first session was seen as a pre-test, and some modifications of the session concept were done according to the lessons learnt during this first session: Specifically, the number of tasks for the second part of the session was reduced from originally planned 6 tasks to 4 tasks, as the completion of the tasks by using the VUI of the App took quite long. Furthermore, while it was originally planned to have the first part of

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 46 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

the session in the office and then move to the car for the second part of the session, it was realised that it was feasible to have the whole usability evaluation session in the car. This was more convenient both for the test users as well as for the facilitators.

All the Usability Evaluation Sessions followed the same process: First the facilitator welcomed the test-user, described briefly the SIMPLI-CITY system, and explained the purpose of the session. Then the facilitator gave an overview of the test procedure and asked the tester for her/his permission that the session can be recorded, and the records can be used for later analysis and reporting purposes. After the test-user signed the consent form, the facilitator encouraged her/him to ask questions, whenever anything is unclear. In a short introductory interview, the facilitator obtained from the test-user some demographic information (gender and age), and some information regarding relevant skills and knowledge, such as familiarity with smartphones and (navigation) apps, and expertise with Thinking Aloud tests.

After this introductory part, the main part of the test-session could begin, which consisted of two settings:

Setting 1: This setting was designed to allow the test-user to become familiar with the app. The test-user was asked to hold the smartphone in the hand and to complete the following 6 test-tasks by using the graphical/touch interface of the app:

- Task 1: You are going to work with the SIMPLI-CITY App's feature "Driving Experience". Your first task is to select Route 1 from the list of saved routes.
- Task 2: Change your selected route to Route 2.
- Task 3: Save your selected Route.
- Task 4: Try to share your current location with your friends on Facebook.
- Task 5: You are interested in tourist attractions along your route – so, select these as Points of Interest (POIs).
- Task 6: Go back to the "Welcome screen" of the App, (this is the first view you see when you start the app, i.e., the screen, where you can select for example "Driving Experience").

Setting 2: This setting was designed to test the usability of the App under in-car conditions. The smartphone was mounted on the dashboard of the car, and the test-user was asked to pretend that she/he is driving (i.e., keeping both hands on the steering wheel as much as possible, and keeping the eyes on the road), while completing the following 4 tasks (i.e., a digest of the tasks done already in test-setting 1) by using mainly the voice-based interface of the app.

- Task 1(VUI): You are going to work with the SIMPLI-CITY App's feature "Driving Experience". Your first task is to select Route 1 from the list of saved routes.
- Task 2 (VUI): Change your selected Route to Route 2.
- Task 3 (VUI): Save your selected Route.
- Task 6 (VUI): Go back to the "Welcome screen" of the App (this is the first view you see when you start the app, i.e., the screen, where you can select for example "Driving Experience").

Annex B of this document, includes the task-sheets, which the test-users got during the usability evaluation session.

While the test-user was working to complete the test-tasks, the observer took notes of all usability issues that became apparent.

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 47 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

After finishing the last test-task, the facilitator thanked the test-user for her/his cooperation and asked the following three questions in the debriefing interview: “How was it?”; “Was there anything that you found to be especially good?”; “Was there anything that you found to be especially bad?” When the test-user finished answering these questions, the facilitator asked her/him to fill-in the System Usability Scale (SUS), a standardised questionnaire to assess a user’s perception of the overall usability of a system. In case the test-user had further questions, these were answered by the facilitator and after that the session was finished.

After each evaluation-session, the facilitators took a time to control the notes and organize them, save the recordings, and prepare the material and setup for the next session.

The average duration of each Usability Evaluation Session was 51 minutes, with the longest one taking 58 minutes and the shortest one having a duration of 45 minutes.

## 5.2.2 Main Findings of the Usability Evaluation

### 5.2.2.1 Main Positive Aspects Mentioned by the Test-Users

Two positive aspects were mentioned by the test users in the Feedback Interview at the end of the Usability Evaluation session.

1. the app’s views are clear and not overloaded

Maria: *“The menu is very clear because there are only few options to select. ... It seems very clear and simple, this is fine for me, there are not too much things, so the visibility is very clear.”*

2. the system’s voice is clear and easy to understand

Merlin: *“The voice of the nice lady is very clear and you can understand her quite easily.”*

### 5.2.2.2 Main Usability Issues Revealed During the Evaluation

During the Feedback Interview at the end of the Usability Evaluation Sessions, the test-users mentioned several aspects of the SIMPLI-CITY system, which should be improved:

1. missing feedback of the system

Maria: *“When you are waiting long for the reaction of the App only an empty screen is shown. It would be fine if something moves, so that I see that the App is working, because I always think Oh I did not press the button right...”*

Herbert: *“There is a lack of feedback. You never know, if the App is just working so slowly or has crashed. Obviously there is a lack of feedback.”*

Merlin: *“You don’t know, if you have done anything wrong or it just does not function.”*

2. menu structure is not clear

Herbert: *“If I choose a menu point I get no indicator if I am in the right menu. If I press “driving experience” I would rather see a heading “driving experience” to show me I have pressed the right menu button.”*

Volker: *"I was not really sure, whether I should start the navigation or I can find this menu point to select a POI somewhere else – so it was not clear. I think it was a little bit of luck, or rather a lot of luck that finally I found the right menu point."*

Herbert: *"...it was just good luck to find the right path so quickly; I would have looked through all menu options, cause I had no clue where to find it..."*

Merlin: *"It is not quite logical for me. Easy functions are not logical. How do I come to the home screen?"*

3. waiting time for system response is too long

Herbert: *"The system is very slow and the answer always came few seconds after I thought it wouldn't come anymore. It is just too late. I can't do thirteen, fourteen or fifteen seconds..., that's way beyond tolerable. Much too late."*

Merlin: *"It makes me irritated and nervous because it lasts so long. Maybe if the function would be more quickly to come to the next section then it would be ok."*

4. having to press the PTT button before each voice input is not convenient

Merlin: *"For me it has no advantage. If I have to press the PTT button all the time, I also could use the touch input and then I would not have to talk and struggle with the app..."*

Volker: *"It is not good that I always have to press the button. I think it would be better when she heard what I say when it works and not always to press the button. I think then it is also easy for me to press the menu on the screen. If I press the button or the menu is the same."*

5. voice-based user interface needs to be improved

Merlin: *"I'm completely occupied with handling the app, and cannot look at the street and cannot see the traffic."*

Volker: *"The voice interface needs to be improved. I have to know what I can say and it should function. Often I didn't know if she understands me."*

Maria: *"To be honest, this handling with the voice brings my nerves down. It doesn't work out. I could never do it in real traffic. I would never use this one."*

Herbert: *"I think that's the most frustrating, it kind of does what you want it to do if you talk to it like to a first grader with bad hearing. I think I would rather park and press the buttons. ..."*

6. in some menus the wording of the VUI is not clear

Merlin: *"When the system asks 'Do you want the map?' I do not know what to do, if I shall say yes, or map..."*

Herbert: *"I found the wording of the menu confusing. Some of the menu points could be more consistent. For example she asks me 'Do you want to 'select a route' or 'saved routes'. 'Do you want to select a route (which I could) that sounds ok, but '[do you want] saved routes' is something completely different. 'Do you want [to select a route or] to load a saved route' would have been more logical for me. These are all small things that are irritants... I think they can sum up and especially while driving this App should be streamlined and not have irritants in it. To be clear, be concise, to have correct speech could be helpful."*

## 5.2.3 Detailed Documentation of the Findings

### 5.2.3.1 Usability Metrics

#### *Task Completion Success Rate*

The task success rate score is the number of participants that finished the task successfully divided by the total number of participants.

In the first test setting (i.e., usage of the App with touch input), all participants were able to complete Task 1, Task 2, and Task 5. For Task 3, Task 4, and Task 6, in each case one participant did not complete the task, since these users gave up when the App crashed several times.

In the second test setting, when the participants were encouraged to try to complete the tasks by voice input, none of the tasks could be completed by all participants using only voice input. For each task at least one of the participants needed touch input. Only one of the participants was able to complete Task 3(VUI) using only voice input, and for completion of Task 4(VUI) all participants needed touch input.

Table 18: Task Completion Success Rate

Participant	Task 1	Task 1 (VUI)	Task 2	Task 2 (VUI)	Task 3	Task 3 (VUI)	Task 4	Task 5	Task 6	Task 6 (VUI)
Volker	✓	(✓)	✓	(✓)	✓	(✓)	✓	✓	-	(✓)
Herbert	✓	✓	✓	✓	-	✓	✓	✓	✓	(✓)
Maria	✓	✓	✓	-	✓	(✓)	-	✓	✓	(✓)
Merlin	✓	✓	✓	✓	✓	(✓)	✓	✓	✓	(✓)
<b>Task completion success rate</b>	<b>100%</b>	<b>100%</b>	<b>100%</b>	<b>75%</b>	<b>75%</b>	<b>100%</b>	<b>75%</b>	<b>100%</b>	<b>75%</b>	<b>100%</b>

✓ = task successfully completed;

(✓) = VUI task: successfully completed, but with touch input

- = not completed / help needed for completion

#### *Ease-of-Task Ratings*

After each task, the participants rated the ease of completing the task, by answering the "Single Ease Question" (SEQ)<sup>9</sup> "Overall this task was?" on a 7-point rating scale ranging from "Very Difficult"(1) to "Very Easy"(7).

Table 8 shows the ratings given to the single tasks by the test-users, and provides an average of these ratings for each task.

<sup>9</sup> Jeff Sauro: "10 Things to know about the Single Ease Question (SEQ)", online at <https://www.measuringu.com/blog/seq10.php>, visited 12.06.2015

Table 19: Ease-of-Task Ratings

Participant	Task 1	Task 1 (VUI)	Task 2	Task 2 (VUI)	Task 3	Task 3 (VUI)	Task 4	Task 5	Task 6	Task 6 (VUI)
Volker	7	2	7	2	7	1	5	6	7	2
Herbert	4	4	1	2	6	1	5	4	7	1
Maria	7	2	7	1	6	1	1	6	7	2
Merlin	7	1	7	1	7	1	4	7	7	1
<b>average Rating</b>	<b>3.1</b>	<b>1.1</b>	<b>2.8</b>	<b>0.8</b>	<b>3.3</b>	<b>0.5</b>	<b>1.9</b>	<b>2.9</b>	<b>3.5</b>	<b>0.8</b>
<b>% Easy (Rating 6 or 7)</b>	<b>75%</b>	<b>0%</b>	<b>75%</b>	<b>0%</b>	<b>100%</b>	<b>0%</b>	<b>0%</b>	<b>75%</b>	<b>100%</b>	<b>0%</b>

The test-users rated the tasks as being much more difficult, when trying to complete them by using the voice interface. Thus, some efforts for fixing the usability issues occurring with the voice interface are required. When looking only at the tasks completed via touch/graphical user interface, Task 4 and Task 5 were assessed as being rather difficult. As this was mainly due to the fact that the test-users had problems with finding the respective menu points, further development to improve the usability with respect to the menu structure of the App is recommended.

#### *Time on Task (TOT)*

The amount of time needed to finish a task varies among the test-users. However, all test-users faced some problems with the vocal interface and with some system issues.

Table 20: Participants' Time-On-Task (TOT)

Participant	Task 1	Task 1 (VUI)	Task 2	Task 2 (VUI)	Task 3	Task 3 (VUI)	Task 4	Task 5	Task 6	Task 6 (VUI)
Volker	01:23	01:47	00:37	01:08	00:42	00:46	01:31	02:57	01:58	02:39
Herbert	01:41	01:18	02:02	03:52	02:25	00:43	00:57	01:57	00:30	00:59
Maria	01:15	03:27	00:37	04:14	00:38	04:24	01:44	01:32	01:32	01:31
Merlin	00:50	05:53	00:12	02:53	00:14	03:32	00:44	00:38	00:11	03:05
<b>Average TOT</b>	<b>01:17</b>	<b>03:06</b>	<b>00:52</b>	<b>03:01</b>	<b>00:59</b>	<b>02:21</b>	<b>01:14</b>	<b>01:46</b>	<b>01:02</b>	<b>02:03</b>

#### *Rating of the Overall System-Usability*

After the completion of all tasks, participants were asked to fill in a standardised feedback questionnaire (SUS System Usability Scale). As already explained in Section 4.2.3.1, SUS yields a single number representing a composite measure of the overall usability of the system. SUS scores have a range of 0 ("not usable at all") to 100 ("perfectly usable system"). Table 21 gives an overview of the answers of the test-users. Analysis of these

answers of the test-users to the feedback questionnaire reveals that the “Driving Experience” App reaches a SUS score of 25.8. This can be translated to users’ perceiving that the usability of the system is “very poor”. This confirms that the App is in a prototype stage, and indicates that there is still significant improvement of the App’s usability necessary.

Table 21: Rating of the Usability of the “Driving Experience” App (SUS score)

SUS Questions	Volker	Herbert	Maria	Merlin
1. I think that I would like to use this system frequently.	1	1	2	1
2. I found the system unnecessarily complex.	3	2	2	2
3. I thought the system was easy to use.	1	1	3	1
4. I would need the support of an experienced person to be able to use this system.	2	1	2	5
5. I found the various functions in this system were well integrated.	1	1	5	1
6. I thought there was too much inconsistency in this system.	4	5	2	5
7. I would imagine that most users would learn to use this system very quickly.	1	4	4	3
8. I found the system very cumbersome to use.	3	5	3	4
9. I felt very confident using the system.	2	2	3	1
10. I needed to learn a lot of things before I could get going with this system.	1	1	1	4
SUS Score (intermediate, per test-user)	32.5	37.5	67.5	17.5
<b>SUS Score (overall average)</b>	<b>25.8</b>			

### 5.2.3.2 Usability Issues Noted by the Facilitators

In the following, the usability issues noted by the observer during the Usability Evaluation sessions are listed in chronological order as they occurred during the sessions:

#### Setting 1 – User’s Interaction with the App via Touch/Graphical User Interface

*Task 1: You are going to work with the SIMPLI-CITY App’s feature “Driving Experience”. Your first task is to select Route 1 from the list of saved routes.*

- Minor usability issue: Test users found it a bit irritating that the next view, after pressing the “Driving Experience” button was the option for the map.
- Severe usability issue: After selecting a route from the list of saved routes, the system switched to an empty screen. The test users were puzzled. They did not know whether they had done the right thing, since it took very long before they got a response from the system (“Route is set...”).

*Task 2: Change your selected Route to Route 2.*

- Minor usability issue: 2 of the 4 test users overlooked the menu option “Change Route”; they pressed the back-button of the phone and started again from the first screen of the app

*Task 3: Save your selected Route.*

- Severe usability issue: after selection of a slot to save the route, the system switched to an empty screen. The test users were puzzled. They did not know whether they had done the right thing, since it took very long before they got a response (“Route is saved...”) from the system.- missing system feedback, as in Task 1

*Task 4: Try to share your current location with your friends on Facebook.*

- Quite important usability issue: all 4 test users faced the problem that they had no clue where to find the right menu point, thus they only could complete this task by trial and error - > they needed to have a look at all available menus in order to find the “Share location” option

*Task 5: You are interested in tourist attractions along your route – so, select these as Points of Interest.*

- Minor usability issue: some of the test-users pressed the “Go to POI” button in the “start navigation” menu, since they hoped to find the possibility to select POIs there
- Severe usability issue: after pressing the “Go to POI” button, the test users could not go back again (the App seemed to be in an endless loop), and thus the test users had to stop and restart the app

*Task 6: Go back to the “Welcome screen” of the App, (this is the first view you see when you start the app, i.e., the screen, where you can select for example “Driving Experience”).*

- Quite important usability issue: the test-users were desperately searching for something like a “home” button to go back to the first screen of the app; but such a button/link did not exist – the only way to go back was by using the back button of the mobile phone
- Minor usability issue: some of the test users tapped on the SIMPLI-CITY logo and expected that this will bring them to the first screen of the App (but it did not work)

**Setting 2: User’s Interaction with the App (mainly) by the Voice-Based User Interface***General Observations regarding the Voice User Interface*

- Quite important usability issue: all test-users forgot to press the PTT button quite often when they wanted to make a voice input – the users expected that it would be sufficient to press the PTT button one time at the beginning of the dialogue
- Quite important usability issue: several times it happened that the user’s voice input was not understood by the system – the users tried it several times and were quite annoyed and frustrated, and finally proceeded by touch input.
- Severe usability issue: After the user’s voice input it took very long until the system responded – Thus, as they got no feedback from the system, most times the users thought that their voice input was not successful and pressed the PTT button again and repeated their voice input. This often interfered with the system’s routines and

resulted in strange behaviour of the system so that the only way to proceed was to stop and restart the system.

- Severe usability issue: None of the test users was able to go back to the first screen of the App by using voice input. Most users tried the command “home” or “go home”, but these did not work. One of the users tried the command “back”, which resulted in the system switching to the previous screen, but the user did not realise that this was the right approach and she/he should have used the “back” command several times.
- Minor usability issue: When the system asked “Do you want the map?” the test users hesitated, since they did not know whether they should answer “yes” (which they would do in a natural dialogue situation) or “map” (which was written on the button).

### 5.2.3.3 Transcription of the Debriefing Interviews

#### Test User Volker (Session 1)

Moderator: “How was it?”

Volker: “This voice task was very hard, very difficult, because she did not understand me and it was very long between my input and the reaction of the app. Most of the things I did on the screen and not via voice. I could not do this while driving. It was really difficult because the voice command does not react like I thought it would. So it was very hard. I think on the street I would give up to use the App because it is too much to look for the App and how it reacts. I would park the car and then I would interact with the app.”

Moderator: “What are the main points you would like to improve if you were a developer?”

Volker: “The voice command. I have to know what I can say and it should function. I don’t know if she understands me. It is also not good that I always have to press the button. I think it would be better when she heard what I say then it works and not always to press the button. I think then it is also easy for me to press the menu on the screen. If I press the button or the menu is the same.”

#### Test User Herbert (Session 2)

Moderator: “How was it?”

Herbert: “It is quite a frustrating experience. Mostly because there is a lack of feedback, obviously if it crashes there is a lack of feedback. Secondly, if I choose a menu point I get no indicator if I am in the right menu. If I press “driving experience” I would rather like to see a heading “driving experience” to show me I have pressed the right menu button. I don’t trust myself, since with my big fingers I often touch on the wrong button, if buttons are close together. That was one thing that I found... Also I found the wording of the menu confusing. Some of them could be more consistent. For example she asks me “Do you want to “select a route” (which I could, that sounds ok), or “saved routes” (which is something completely different). “Do you want to load a saved route” would have been logical for me. These are all small things that are irritants... I think they can sum up and especially while driving this App should be streamlined and not have irritants in it. To be clear, be concise, to have correct speech could be helpful. The system was very slow and the answer always came few seconds after I thought it wouldn’t come anymore. It is just too late. I can’t do thirteen, fourteen or fifteen seconds..., that’s way beyond tolerable.

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 54 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

*Much too late. I think that's the most frustrating; it kind of does what you want it to do if you talk to it like to first grader with bad hearing. I think I would rather park and press the buttons. Yes, it is doable, but who would..."*

Moderator: *"Was there anything you found good?"*

Herbert: *"I cannot answer this at this stage of development - This is just a menu system at the moment – it still can become good during further development."*

### **Test User Maria (Session 3)**

Moderator: *"How was it?"*

Maria: *"To be honest, this handling with the voice brings my nerves down. It doesn't work out. I could never do it in real traffic. I would never use this one. And another one with manual handling I think if I get used to it maybe I would use it. It is easier, it works and you know if I push the button it works. But if you answer you don't know if the system recognized it or not. Do you wait a little bit longer...? This is not really user friendly for me, I got really nervous."*

Moderator: *"Was there anything good?"*

Maria: *"The menu is very clear because there are only few options to select and also the voice of the nice lady is very clear and you can understand it quite easily. I think the only thing which does not work good is the respond, you don't know if it is working, or did I talk not loud enough. It seems very clear and simple, this is fine for me, there are not too much things, so the visibility is very clear."*

### **Test User Merlin (Session 4)**

Moderator: *"How was it?"*

Merlin: *"There is no advantage to have this thing, because it makes me irritated and nervous because it lasts so long and it is not quite logical for me. Easy functions are not logical. How do I come to the home screen for example. The menu structure was first not clear to me, I did not know what I shall do, where I can find this option – I just tried it out... so it was difficult. And often you don't know if you have done anything wrong or it just does not function. It is not easy and not helpful in any case. If I were a car driver it would not help me."*

Moderator: *"Was there any aspect that you found good?"*

Merlin: *"... maybe if the task, if the function would be more quickly to come to the next section then it would be ok. To say the route or tourist attraction that could be helpful, but for me it would not be helpful because I have to think a lot how to handle this App and would not be concentrated on driving."*

## 5.3 Functional Evaluation of the Use Case II.2 related App

This chapter presents the results of the Functional Evaluation of the “Driving experience” application that cover the Use Case Topic II.2 “Rising the Driver’s Comfort”.

In Section 5.3.1 the Functional Evaluation approach is described briefly, and Section 5.3.2 gives a summary of the results of the Functional Evaluation.

### 5.3.1 Approach Taken for the Usability Evaluation

The Functional Evaluation aims to validate that the SIMPLI-CITY system functions under real-world conditions.

#### 5.3.1.1 Applied Methods for the Functional Evaluation

For each of the scenarios implemented, some test cases derived from the Functional Specification were defined and executed in real traffic conditions in order to demonstrate the coverage of the requirements for each scenario.

#### 5.3.1.2 Actors Involved in the Functional Evaluation

Functional Evaluation of the Use Case II.2 related App “Driving experience” was performed by Worldline in Barcelona. The evaluation was conducted by a team composed of three people:

- The first one was the driver, which just drove the car (use of cell phones or any other mobile device by a car driver while driving is not allowed in the city of Barcelona and heavily fined).
- The second one was the test user, testing the App functionality and taking screen shots for documental purposes when required by the observer.
- The third one was the observer, which asked the test user to perform the defined test cases, and took notes of the results.

#### 5.3.1.3 Equipment

The only required equipment was a smartphone. We used two different smartphones for the tests, a Nexus 5 running Android 4.4, and a Samsung Galaxy S5 running Android 5.0, getting identical results from a functional point of view with both devices.

The smartphone was connected via 3G to the SIMPLI-CITY SRE. Several areas of the city of Barcelona are also covered with a free WiFi service, and some tests were performed taking advantage of that connection. However in this case the results were uneven due to the instability of the connection, which was finally discarded as a suitable connection service for SIMPLI-CITY.

#### 5.3.1.4 Functional Evaluation Session

The final Functional Evaluation Session took place in Barcelona, Spain during the last week of October 2015.

The test user drove the vehicle along the route from Worldline headquarters in Barcelona, located in the technological neighbourhood of the city (called 22@), to the Barcelona Airport, located in El Prat de Llobregat village, on the opposite side of the city. The driver

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 56 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

took the shortest (but slowest) route through the city centre, which required crossing a large section of the city.

### 5.3.1.5 Test Cases

The test cases defined for the Functional Evaluation of the “Driving experience” application are listed in the following table. These test cases were defined taking into account the main functionalities implemented in the application as described in deliverable D8.2.

Table 22: Test Cases for Functional Evaluation

Test Case Id	Test Case Title	Test Case Description
Test1	Trip setup	Check your current position and establish the destination (Task to be done before the trip)
Test2	Get POIs	Start navigate the route and get information about the closest POIs according to the selected type (Task to be done during the trip)
Test3	Go to POI	While on route, select a POI and change the route to go to that POI (Task to be done during the trip)
Test4	Social networking	Share either your location or the selected POI through social networks (Facebook or others) and provide comments (Task to be done during the trip)
Test5	Route management	Save the selected route or recover already saved routes (Task to be done before, during or after the trip)

### 5.3.1.6 Use Case Requirements Relevant for Functional Evaluation

The requirements specified in the deliverable D2.3 at the beginning of the project included also some requirements that are specifically relevant for the Use Case II.2 related “Driving experience” App.

Table 23: Use Case Requirements Relevant for “Driving Experience” App

Id	Requirement Description	Priority
U209	Provision of real-time information about the current route	Must Have
U210	Reproduction of multimedia information	Must Have
U211	Reproduction of streaming audio	Should Have
U212	Notification to end user about the proximity of Points of Interest	Must Have
U213	Social network integration	Must Have

### 5.3.2 Results of the Functional Evaluation

The Table below indicates the relevance of the use case requirements for each test case performed during the Functional Evaluation.

Table 24: Test Cases vs Use Case Requirements

Test Case		U209	U210	U211	U212	U213
Test 1	Trip setup	✓				
Test 2	Get POIs	✓			✓	
Test 3	Go to POI		✓	✓		
Test 4	Social networking					✓
Test 5	Route management	✓				

The “Driving experience” application offers a navigation tool to the driver that allows identifying and selecting Points of Interest on the planned route, getting information about them, sharing them through social networks, and changing the route towards them. The defined test cases cover requirements U209-U213 as shown in the previous table, however none of the POIs on the route contained any audio streaming source of information, so it was not possible to test U211 in real conditions. However, lab tests have shown that this function is working as expected.

### 5.3.3 Performed Test Cases

In the following sections a brief description of each test case, which was performed by the test user using the “Driving experience” application installed on the smartphone, is given.

### 5.3.3.1 Test 1: Trip Setup

In the vehicle, before starting the trip, the test user first checks the current position recognised by the app, which was retrieved from the GPS sensor of the mobile device. Then the test user selects the destination, which may include several combinations of street, number, city and country. For example, when only the name of the city is given, the App selects the centre of that city as destination. Finally, the test user starts the navigation function and the App shows in a map the selected route. The following picture shows the screen shots at that time.

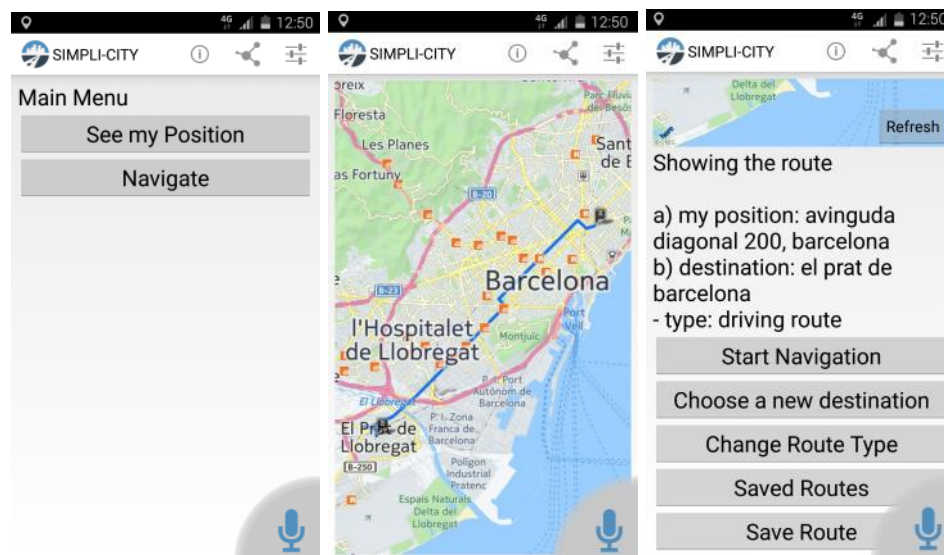


Figure 18: Driving Experience Test 1 – Setting up the Application

At this point, the test user saves the selected route in order to use it later on. This is reported in Test 5.

### 5.3.3.2 Test 2: Get POIs

In the vehicle, before starting driving, the test user selects the type of Points of Interest (POIs) that she/he wants to look for, in this case it was Hotels. The App shows immediately the closest hotels to the current position of the driver. At the middle of the route, while driving, at Aragó Street 284, the test user looks again for POIs and gets information about them. The App shows all available information on those POIs, in this case, the names and addresses.

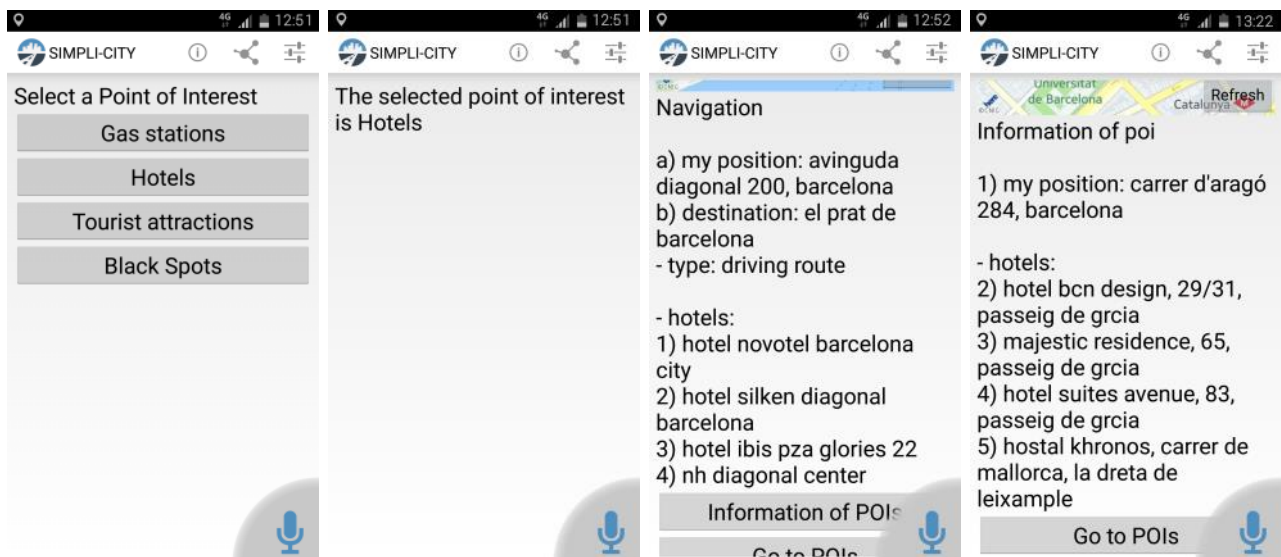


Figure 19: Driving Experience Test 2 – Getting Information about POIs

### 5.3.3.3 Test 3: Go to POIs

When driving at Aragó Street 233, the test user looks again for POIs and decides to change the route. For that purpose the test user selects the option to change the route, and selects one of the POIs that are shown. In this case the Hotel Condés de Barcelona was chosen. The destination of the route is immediately changed to the selected POI.

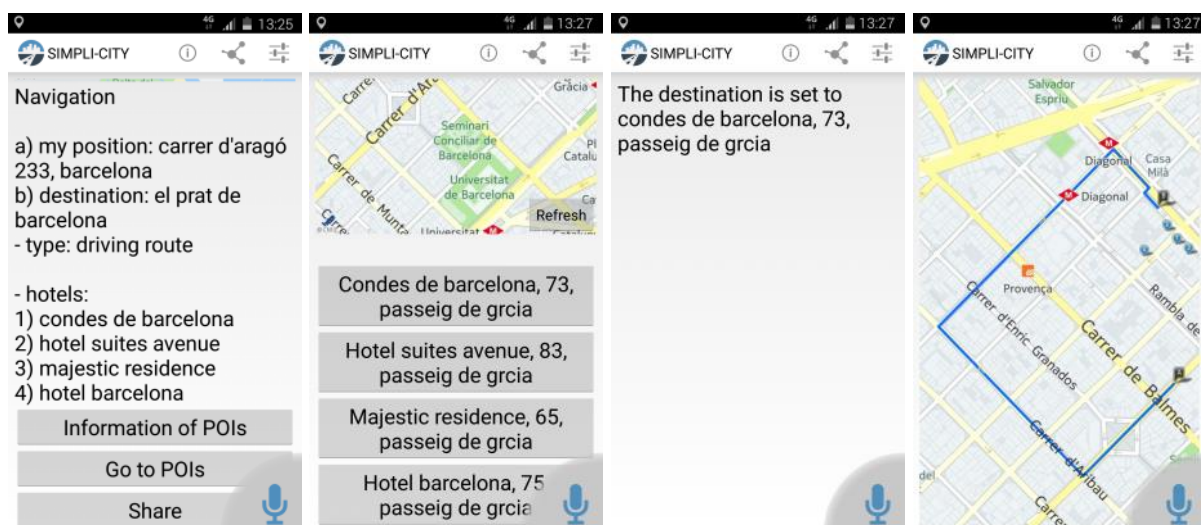


Figure 20: Driving Experience Test 3 – Changing the Route to a Selected POI

### 5.3.3.4 Test 4: Social Networking

The test user decides to add a comment, “Very nice hotel”, to the POI to share it through social networks. The App works with Facebook as main social network, and requires that the test user has a Facebook account and is logged in to it. In addition, the App allows also sharing through any other installed application, such as via Whatsapp, SMS or an Email client.

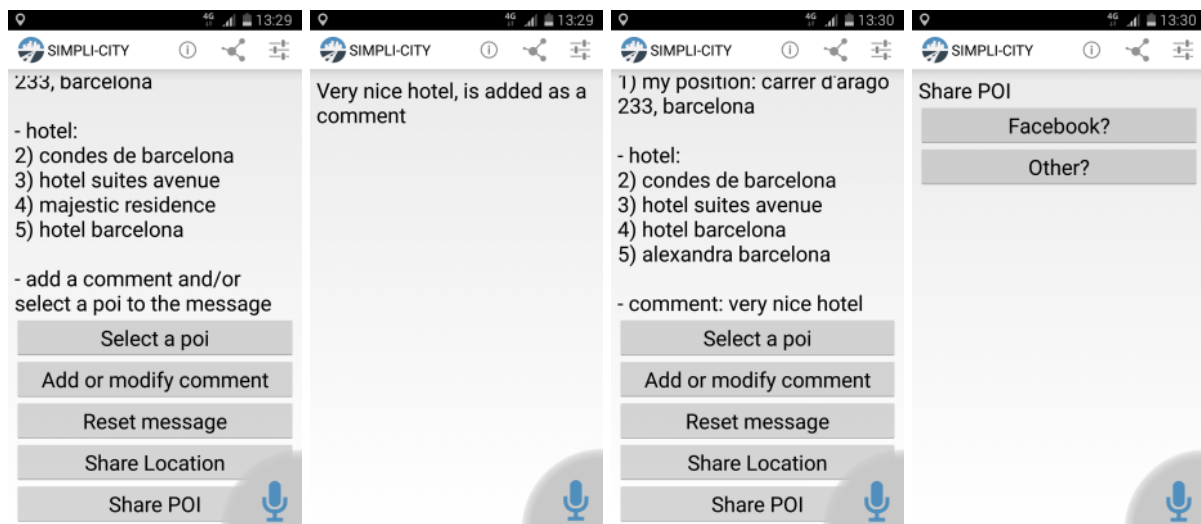


Figure 21: Driving Experience Test 4 – Sharing Information through Social Networks

### 5.3.3.5 Test 5: Route Management

After completing the setup (Test case 1), the test user decides to save the route, giving it the name “Airport”. The route will be saved and is available for a later point of time. This process can be seen in the Figure 22..

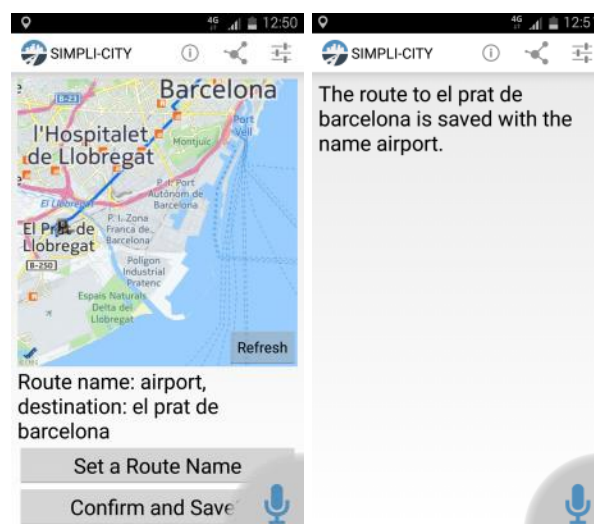


Figure 22: Driving Experience Test 5 – Saving the Current Route

After selecting a route to a POI (Test case 3) and sharing information on the social networks (Test case 4), the test user decides to go back to the original route by selecting the previously saved “Airport” route.

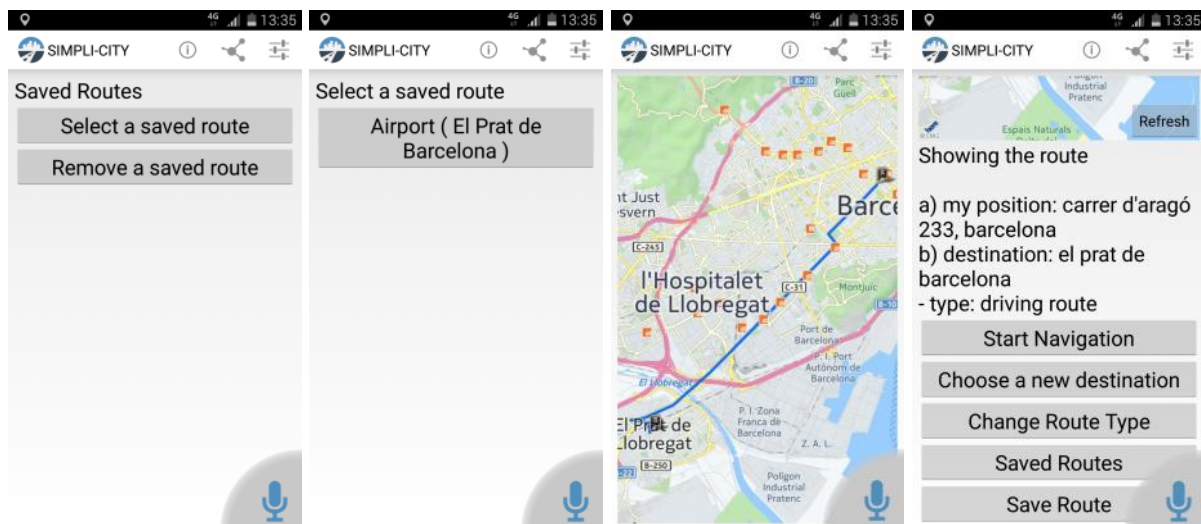


Figure 23: Driving Experience Test 5 – Selecting a Saved Route

### 5.3.4 Achieved Results

The following Table 25 summarises the results revealed by the Functional Evaluation of the “Driving experience” App with respect to the related requirements.

Table 25: Results of the Functional Evaluation

	Requirement Description	Grade of Fulfilment	Explanation
U209	<b>Provision of real-time information about the current route</b> Applications related with navigation should provide real-time information about the current route of the user. This information may include Points of Interest (POIs), parking slots, traffic information, alternative routes, or alternative public transport, depending on the needs of the application.	completely fulfilled	In the case of the “Driving experience” app, the information provided is related to a selected type of POI. The App also provides routes with other transport means and allows changing the final destination to a selected POI.
U210	<b>Reproduction of multimedia information</b> Applications developed for the SIMPLI-CITY platform should be able to reproduce multimedia, including audio and video. They should support the standard multimedia formats.	partially fulfilled (video excluded)	The App is able to reproduce several multimedia formats, but not video. In fact, additional information on POIs is almost always just textual, even audio is unusual.
U211	<b>Reproduction of streaming audio</b> Applications developed for the SIMPLI-CITY platform should be able to reproduce streaming audio from different data sources. They should support standard streaming audio formats.	completely fulfilled	This function could only be tested in lab conditions. In the real scenario it was not possible to find any POI which included streaming audio as additional information.

	Requirement Description	Grade of Fulfilment	Explanation
<b>U212</b>	<b>Notification to end user about the proximity of Points of Interest</b> Applications developed for the SIMPLI-CITY platform should be able to notify end users about the proximity of Points of Interest. This notification should be proactive by the platform, meaning that the server should be able to detect the proximity of the user to the Point of Interest, and then notify the application of this proximity so that the application can inform the user.	completely fulfilled	The App provides information while in route on the selected type of POI, providing a list of the ones closest to the driver at any moment.
<b>U213</b>	<b>Social network integration</b> Applications developed for the SIMPLI-CITY platform should be able integrate with social networks such as Facebook or twitter, in order that users can publish information in these social networks and share information with their contacts through the SIMPLI-CITY applications.	completely fulfilled	The App provides to the user the possibility of sharing either the current position or the selected POI through Facebook or any other application already installed in the device.

## 6 Summary and Conclusions

The evaluation strategy followed within SIMPLI-CITY aimed to reach two main objectives:

- to evaluate the prototypes developed within SIMPLI-CITY against the requirements specified within deliverable D2.3 “Requirements Analyses Report”
- to validate the applicability of the SIMPLI-CITY prototypes in a real-world setting

### *Evaluation of the SIMPLI-CITY Prototypes Against the Specified Requirements*

During the specification phase in the beginning of the project, 12 requirements with priority “Must Have” or “Should Have” were defined, which were relevant for the Use Case II related Apps. The Technical Evaluation of the SIMPLI-CITY prototypes showed that 10 of these 12 requirements were completely fulfilled. The remaining 2 of these requirements were partially fulfilled, mainly due to the fact that the priorities and specification details changed slightly during the course of the project.

### *Evaluation of the Applicability of the SIMPLI-CITY Prototypes in a Real-World Setting*

In order to evaluate, how easy the Use Case II related Apps developed within SIMPLI-CITY can be used by real users, several Usability Inspection activities involving experts as well as Usability Evaluation activities involving test-users were conducted during the project. The Usability Inspection and Usability Evaluation were designed as formative evaluation: in order to allow the SIMPLI-CITY developers to implement further improvements to the system based on the findings of the evaluation, Usability Inspection/Evaluation was conducted in phases starting from June 2015 to September 2015. For all components of the SIMPLI-CITY system several useful hints for improvement of their usability were obtained by the Usability Inspection/Evaluation. Many of these improvements suggested by the results of the Usability Inspection/Evaluation were implemented by the SIMPLI-CITY developers immediately. Even the suggestions of the last usability evaluation activities, which were conducted in September 2015, were taken into account for further improvements of the Use Case II.2 related App in October 2015. However, of course not all of the revealed usability issues could be solved during the runtime of the project, but the remaining usability issues are well documented and constitute valuable contributions for further developments of the SIMPLI-CITY prototypes.

In order to evaluate, how well the SIMPLI-CITY prototypes are functioning under real-world conditions, Functional Evaluation activities were carried out for both Use Case II related Apps. The performance of the Use Case II.1 related App in a real car in real traffic was evaluated by CRF in Turin, and the performance of the Use Case II.2 related App was evaluated by WORLD in Barcelona. The results of these Functional Evaluation activities pointed out that the prototypes of the SIMPLI-CITY Apps are fully functioning in real usage, i.e., the Apps fulfilled all specified “Must Have” and “Should Have” requirements when used in a real car on the road.

## Annex A: Task Sheets for Usability Evaluation, Use Case II.1 related App

TASK DI ESEMPIO:

**Trova all'interno della App SIMPLI-CITY le impostazioni relative all'attivazione delle notifiche sonore.**

Comunica al moderatore quando ritieni di aver portato a termine il task.

Rispondi alla seguente domanda:

**In generale, come hai trovato questo task?**

**Molto difficile**

**Molto facile**

☐ ☐ ☐ ☐ ☐ ☐ ☐

**TASK 1:**

**Il tuo prossimo viaggio è andare a Mirafiori e il sistema lo sa. Vuoi vedere le informazioni relative al viaggio che stai per intraprendere.**

Comunica al moderatore quando ritieni di aver portato a termine il task.

Rispondi alla seguente domanda:

**In generale, come hai trovato questo task?**

**Molto difficile**

**Molto facile**

☐ ☐ ☐ ☐ ☐ ☐ ☐

**TASK 2:**

**Trova un'altra strada rispetto a quella usuale che ti permetta di massimizzare il tuo punteggio eco.**

Comunica al moderatore quando ritieni di aver portato a termine il task.

Rispondi alla seguente domanda:

**In generale, come hai trovato questo task?**

**Molto difficile**

**Molto facile**

☐ ☐ ☐ ☐ ☐ ☐ ☐**TASK 3:**

**Vuoi migliorare il tuo punteggio eco (rispetto a quello ottenuto sino ad ora) del prossimo percorso.**

Comunica al moderatore quando ritieni di aver portato a termine il task.

Rispondi alla seguente domanda:

**In generale, come hai trovato questo task?**

**Molto difficile**

**Molto facile**

☐ ☐ ☐ ☐ ☐ ☐ ☐**TASK 4:**

**Vuoi vedere qual è il tuo punteggio medio attuale sulla “decelerazione” in uno dei tuoi viaggi abituali registrati nella app.**

Comunica al moderatore quando ritieni di aver portato a termine il task.

Rispondi alla seguente domanda:

**In generale, come hai trovato questo task?**

**Molto difficile**

**Molto facile**

☐ ☐ ☐ ☐ ☐ ☐ ☐

## Annex B: Task Sheets for Usability Evaluation, Use Case II.2 related App

**TASK 1:**

You are going to work with the SIMPLI-CITY App's feature "Driving Experience".  
Your first task is to select Route 1 from the list of saved routes.

Tell the moderator, when you finish this task.

Then answer the following short question:

Overall, this task was?

Very Difficult

Very Easy

☐ ☐ ☐ ☐ ☐ ☐ ☐**TASK 2:**

Change your selected Route to Route 2.

Tell the moderator, when you finish this task.

Then answer the following short question:

Overall, this task was?

Very Difficult

Very Easy

☐ ☐ ☐ ☐ ☐ ☐ ☐**TASK 3:**

Save your selected Route.

Tell the moderator, when you finish this task.

Then answer the following short question:

Overall, this task was?

Very Difficult

Very Easy

☐ ☐ ☐ ☐ ☐ ☐ ☐

**TASK 4:****Try to share your current location with your friends on Facebook.**

Tell the moderator, when you finish this task.  
Then answer the following short question:

**Overall, this task was?****Very Difficult****Very Easy**☐ ☐ ☐ ☐ ☐ ☐ ☐**TASK 5:****You are interested in Tourist attractions along your route – so, select these as Points of Interest.**

Tell the moderator, when you finish this task.  
Then answer the following short question:

**Overall, this task was?****Very Difficult****Very Easy**☐ ☐ ☐ ☐ ☐ ☐ ☐**TASK 6:****Go back to the “Welcome screen” of the App,  
(this is the first view you see when you start the app, i.e., the screen,  
where you can select for example “Driving Experience”).**

Tell the moderator, when you finish this task.  
Then answer the following short question:

**Overall, this task was?****Very Difficult****Very Easy**☐ ☐ ☐ ☐ ☐ ☐ ☐

## Annex C: Briefing Notes for Usability Inspection, Use Case II.1 Related App

### Introduction

#### **About this Document**

This document shall act as a guideline for the expert evaluators, who conduct the Usability Inspection of the Use Case II.1 related SIMPLI-CITY App “Environmental Awareness Rising”.

#### **Purpose and Scope of the Usability Inspection**

This Usability Inspection is done in order *to assess the usability of the PMA with the SIMPLI-CITY App “Environmental Awareness Rising”*. The results of this Expert Evaluation will give valuable *hints for further improvement of the SIMPLI-CITY system*.

#### **Context Information**

During this Expert Evaluation the Use Case II.1 (“Environmental Awareness Rising”) related SIMPLI-CITY App will be inspected.

Product name and version	SIMPLI-CITY App - Eco Live Assistant V1.0
Short product description	<p><i>Purpose of the product:</i></p> <p>Provide a set of services aimed to improve the user’s eco driving behaviour</p> <p><i>Main functions of the product:</i></p> <p>The Eco Live Assistant offers:</p> <ul style="list-style-type: none"><li>• a Trip Assistant able to supply current trip information</li><li>• suggestion about possible Alternative Eco Routes</li><li>• continuous monitoring of the eco driving progress and comparison with the score achieved previously, when travelling the same route, in order to stimulate a continuous self-improvement</li><li>• access to all historical information about travelled trips and driving style</li></ul>

Users	<p><i>User Types:</i></p> <ul style="list-style-type: none"> <li>environmentally conscious car drivers, who, while possessing a private car, aim to minimise the impact of the vehicle on the environment</li> </ul> <p><i>Relevant Skills, Knowledge, and Experience:</i></p> <ul style="list-style-type: none"> <li>good English language skills (but not necessarily English native speaker)</li> <li>good Italian language skills</li> <li>familiar with using Apps on the Smartphone</li> </ul>
Tasks	<p>Tasks related to Use Case II.1:</p> <ol style="list-style-type: none"> <li>Show your next trip using car position and information from your agenda (Task to be done before the trip)</li> <li>Find an alternative route that allows to maximise your eco-score (task to be done before the trip)</li> <li>Improve your eco-score along your commuting route (Task to be done during the trip)</li> <li>Browse your trip history (Task to be done not during the trip)</li> </ol>
Environment	<p><i>Technical Environment (Hardware, Software, Network Environment):</i></p> <ul style="list-style-type: none"> <li>Smartphone LG Nexus 4 or 5 with operating system Android version 4.4 or higher</li> <li>CRF vehicle Connector, SIMPLI-CITY PMA and SIMPLI-CITY App installed on the Smartphone</li> <li>Internet Connection: at least 3G for connectivity with the backend services</li> <li>In order to get car data, the Smartphone should be paired with the Car OBU (uconnect); after the first time the Smartphone recognizes the car OBU as soon as the Bluetooth is activated</li> </ul> <p><i>Physical Environment:</i></p> <ul style="list-style-type: none"> <li>The App will be used in the car → i.e., the App will be used in variable light conditions and variable acoustic conditions</li> <li>Task 3 mentioned above will be performed while driving the car → i.e., the Smartphone cannot / should not be hold or touched during driving, and visual information on the screen cannot / should not be observed while driving</li> </ul>

### ***The Usability Inspection Method Applied***

For Expert Evaluation of the SIMPLI-CITY App “Environmental Awareness Rising” the well-established Usability Inspection method “*Heuristic Evaluation*” is applied:

3 evaluators examine the App, and assess its compliance with a list of “heuristic” usability principles. The evaluators will follow the task-based Heuristic Evaluation methodology, and examine the App by following the user’s main tasks as listed in the previous section. The evaluators will examine both the graphical user interface (GUI) and the voice-based user

interface (VUI) of the App. The evaluators will take into account the use context (e.g., one of the tasks is expected to be done during driving a car)

The evaluators are advised to work alone, without communicating with the other experts in the evaluation team. Each evaluator delivers a list of usability issues she/he has discovered. The evaluator's lists are consolidated and combined in the "heuristic evaluation report", which serves as an indication of possible areas for improvements.

The list of heuristic usability principles is at the core of the "Heuristic Evaluation" method. For the Heuristic Evaluation of the SIMPLI-CITY App, the experts will use the following set of 12 usability principles as reference. This list of "*Usability Heuristics for touchscreen-based mobile devices with voice—based user interfaces*" is compiled based on Jakob Nielsen's "10 general principles for interaction design", the "Usability Heuristics for Touchscreen-based Mobile Devices", the "Usability Checklist for Voice-based User Interfaces", and Gerry Gaffney's "Voice Interaction Checklist". In addition, the experts recruited in CRF will also consider the compliance with the major guidelines and best practice applied in FIAT for the building of HMI usable in the car environment.

#### Usability Heuristics for Touchscreen-based Mobile Devices with Voice-based User Interfaces

##### 1 Visibility of system status / Suitable feedback

the application should provide feedback to every action of the user; the application should inform the user about successful/not successful recognition of the user's input; the application should keep the user informed about all processes and state changes in a reasonable time; if the application takes a longer processing time, the user should be informed about the current state and also about the expected duration of this waiting time;

##### 2 Match between the system and the real world

the application should speak the user's language with words, phrases and concepts familiar to the user; real-world conventions should be followed, and information should be displayed in a logical and natural order;

###### Voice-based UI:

the dialogue structure should resemble human dialogue, and alternative options should be clearly delineated by clear pauses;

##### 3 User control and freedom

the application should allow the user to undo and redo her/his actions, and it should provide "emergency exits" to leave the unwanted state. The user should be allowed to walk through the dialogues in her/his own pace. The user should be able to interrupt at any time, and shouldn't be forced to pass through the extended dialogue. The application should provide a clear way to return to a starting point or main menu.

##### 4 Consistency and standards

the application should follow the established conventions; the user should be able to do things in a familiar, standard and consistent way.

##### 5 Error prevention

in order to prevent errors non-available functionalities should be hidden or disabled, and the user should be able to get additional information about all available functionality. Users should be warned when errors are likely to occur. The application should provide feedback to the user, when the user's input has not been understood, and ask for more information, if the user's input has been ambiguous or inconsistent. The application should use a dialogue strategy based on confirmation;

### Usability Heuristics for Touchscreen-based Mobile Devices with Voice-based User Interfaces

#### 6 Help users recognise, diagnose, and recover from errors

error messages in the application should be expressed in plain language (no abbreviations, no codes), precisely indicating the problem, and constructively suggesting a solution.

#### 7 Customisation and shortcuts

the application should provide basic configuration options and should give expert users access to advanced configuration options. The application should provide shortcuts to the most frequent tasks and should allow their customization or definition. The application should provide suitable messages that match the level of a variety of users. The application should allow step-by-step actions for novices and more complex inputs for advanced users;

#### 8 Aesthetic and minimalist design

the application should use simple and clear language, and short sentences; the information given should be concise, correct, and relevant

#### 9 Minimise the user's memory load

the user should not have to remember information from one part of the dialogue to another. Objects and options should be visible, and instructions for use should be easily retrievable.

##### Voice-based UI:

The application should take into account that users' auditory memory is limited to a few short items; the menu structure should be simple with no unnecessary levels; there should not be more than five options in any menu;

#### 10 Help and documentation

Whenever the user needs it (at any stage of the dialogue), the application should provide easy-to-retrieve instructions and help, centred on the user's current task. A list of concrete steps to carry out should be provided.

#### 11 Interaction and ergonomics

##### Touch UI:

user interface elements should be placed in a recognisable position and should fit the natural posture of the hand.

##### Voice-based UI:

the application's outputs should be clear, with natural intonation and rhythm; the application should understand natural user speech, and be tolerant of differences in accent and speech patterns; the application should recognise male, female and child voices equally well; the system should be tolerant of noise;

#### 12 Privacy

information about how personal data is protected and about content's copyright should be given

## Usability Inspection – Step by Step

### ***Step 1: Establish the Evaluation Team and Distribute the Tasks***

The usability inspection of the SIMPLI-CITY App “Environmental Awareness Rising” shall be done by a team of 3 evaluators in Turin. The evaluators should be experienced Android Smartphone users, and preferably they should be familiar with a LG Nexus 4 or 5.

In addition to the two tasks “Usability Inspection of the App” and “severity rating of the usability issues found”, which need to be done by each of the 3 evaluators on their own, there are also additional tasks to do:

1. combine the single lists of the 3 evaluators into a consolidated list of findings
2. collect the severity assessments of the 3 evaluators, and calculate the average severity rating for each of the usability issues included in the consolidated list
3. prepare the Usability Inspection Report according to the template

These 3 tasks shall be done by the “Usability Inspection lead”, who can either be one of the evaluators or an additional person.

### ***Step 2: Organise Equipment***

The evaluators need to do the Usability Inspection of the SIMPLI-CITY App on a LG NEXUS 4 or 5 Smartphone with Android version 4.4 or higher. The SIMPLI-CITY PMA, the SIMPLI-CITY App, and the CRF Vehicle Connector should be installed on this Smartphone.

In addition to the Smartphone, each evaluator should have a computer (laptop or PC) for immediately recording the findings while doing the inspection work.

**Step 3: Plan Timeline**

preparatory work  
(establish evaluation team, organise equipment)

↓ (do this as early as possible to ensure that the envisaged team members reserve the time for doing the usability inspection...)

conduct usability inspection:  
each member of the evaluators' team should work on her/his own and deliver a list of the notable positive features and potential usability issues found

Note: if only one suitable test-smartphone is available, the usability inspection can be conducted by one evaluator after the other using the same smartphone. Of course, such a consecutive conduction of the usability inspection needs to be taken into account, when planning the timeline.

↓ agree with the evaluators' team on a deadline for delivering their results-lists

combine the 3 results-lists of the evaluators into one consolidated list including all findings of all 3 evaluators, and provide this consolidated list to the 3 evaluators

↓ agree on a deadline for distributing the consolidated list to the evaluators

rate severity of the usability issues:  
each of the 3 evaluators shall go through the consolidated list and assess the severity of the usability issues included in this list

↓ agree with the evaluators team on a deadline for delivering their results-lists

calculate average ratings from the assessments of the 3 evaluators, and create a report of the results of the Usability Inspection according to the template

↓ agree on a deadline for distributing the consolidated list to the partner responsible for creating the report

evaluation report  
deliver the "evaluation report" as early as possible (by end of August at the very latest!)

## Step 4: Conduct the Usability Inspection

### Step 4a: Heuristic Evaluation by each Evaluator

Important: Each of the 3 evaluators shall do the Usability Inspection on their own (without communicating with the other team members)

The evaluator works on the Smartphone with the SIMPLI-CITY App trying to complete the “user tasks” based on the task list given in the “Context Information” section of this briefing notes. While working with the SIMPLI-CITY App, the evaluator records her/his observations as a list of positive findings and a list of problems, and takes screenshots for documentation.

Each observed issue should be documented and illustrated by a corresponding screenshot. The method how to take a screenshot on a Smartphone depends on the device and the Android version.<sup>10</sup> On a LG Nexus 4 running Android 4.0 or higher, a screenshot can be taken by simply pressing and holding the power and volume down buttons at the same time for 1-2 seconds until a shutter noise and flashing of the screen indicate that the screenshot has been taken successfully. For the Usability Inspection exercise, where a lot of screenshots have to be taken, it is quite convenient to automatically transfer the pictures taken to a computer. For this task several Apps are available. (e.g., Dropbox can be configured so that the pictures taken are automatically transferred to a dedicated folder on Dropbox), from where they can easily be retrieved.

It is recommended to create an Excel spreadsheet for recording the findings according to the structure depicted in the following tables:

Description of the Observed Positive Finding (clear description including an indication of the task and view where this positive finding was observed)	Related Heuristic / related usability principle for HMI use in a car	Corresponding Screenshot (file-name)

Description of the Observed Usability Issue (clear description including an indication of the task and view where this problem was observed)	Violated Heuristic / violated usability principle for HMI use in a car	Corresponding Screenshot (file-name)

<sup>10</sup> Instructions of „How to take a screenshot on an Nexus 4/5” can be found in the internet, e.g., <http://www.pcadvisor.co.uk/how-to/google-android/3446798/how-take-screenshot-on-android-phones-tablets/>

As result of her/his evaluation exercise each expert submits a zip-file containing the lists of her/his observed problems and the related screenshots, as well as the list of positive findings.

#### **Step 4b: Consolidated List of Findings**

To avoid duplicate problems, the lists from the 3 evaluators must be consolidated and combined into one “List of Findings”. The resulting spreadsheet should have the following structure:

Description of the Observed Positive Findings	Related Heuristic / related usability principle	Reported by Evaluator			Corresponding Screenshot(s) (file-name(s))
		...*	...*	...*	
		X		X	
			X		
				X	

Description of the Observed Usability Issue	Violated Heuristic / violated usability principle	Severity Assessment	Reported by Evaluator			Corresponding Screenshot(s) (file-name(s))
			...*	...*	...*	
			X		X	
				X		
					X	

(...\* insert the initials of the evaluators)

#### **Step 4c: Severity Rating of Usability Problems Found**

Each of the 3 evaluators works with the consolidated “List of Findings” on her/his own, and assesses the severity of each of the usability problems found.

For each problem, the evaluator assesses the severity according to the following scale:

- 0 I do not agree that this is a usability problem at all
- 1 cosmetic problem (is not necessary to be fixed)
- 2 medium severe usability problem (should be fixed)
- 3 usability catastrophe / safety relevant problem (imperative to fix this before product can be released)

When assessing the severity/criticality of the problem, the evaluator takes into account the frequency with which this problem occurs (common or rare), and the impact of the problem, if it occurs (easy or difficult for the user to overcome).

Again, the individual lists of the 3 evaluators are combined into one list: For each usability problem in the list, the individual severity assessments of the 3 evaluators are combined into an average severity rating. Finally, in the consolidated list, the usability problems

found are ordered according to their severity rating, so that the most critical problems appear first in the list.

### ***Step 5: Report the Results***

Prepare the “Usability Inspection Report” according to the template. illustrate the findings with screenshots, and add explanatory drawings (if applicable).

## **Checklist for Usability Inspection**

- ☐ establish evaluators-team, hand over the “briefing notes” and assign roles for team-members
- ☐ agree timeline with the team (define date(s) for the deadlines)
- ☐ organise and setup equipment (install and check software)
- ☐ conduct heuristic evaluations
- ☐ prepare consolidated list of findings
- ☐ assess severity of the usability issues found
- ☐ prepare structured “Usability Inspection Report” according to the template

## Annex D: Briefing Notes for Usability Evaluation, Use Case II.1 Related App

### Introduction

#### **About this Document**

This document shall act as a guideline for the facilitator-team, who organises, prepares and conducts the Usability Evaluation of the SIMPLI-CITY App related to the Use Case “Environmental Awareness Rising”.

#### **Purpose and Scope of the Usability Evaluation by Road-Users**

This Usability Evaluation is done in order *to find out how easy road-users can use the SIMPLI-CITY App* related to the Use Case “Environmental Awareness Rising”. The results of this Usability Evaluation will give valuable *hints for further improvement of the SIMPLI-CITY system*.

This Usability Evaluation will look at the interaction of the test-users with the SIMPLI-CITY App “Eco Live Assistant” and the PMA.

#### **Sequence of Test-Settings Simulates the Use Context**

The SIMPLI-CITY App “Eco Live Assistant” provides a multimodal dialogue interface, comprising of a graphical/touch user interface (GUI) and a voice-based user interface (VUI) at the same time. Usually a user will strongly rely on the graphical/touch user interface, when trying the App for the first time(s) e.g., at home or in the parked car. However, in order to minimise driver distraction, when driving a car, interaction with the App during driving shall be done using mainly the voice-based user interface. In order to emulate these use contexts, and in order to allow the test-user to become familiar with the App before using it “under driving conditions”, each Usability Evaluation session will include the following sequence of test-settings:

- **Test-Setting 1: Usability Evaluation under “laboratory conditions”**  
The test-user holds the Smartphone in her/his hands and performs the test-tasks by interacting with the App via the graphical/touch user interface.
- **Test-Setting 2: Usability Evaluation under “simulated in-car conditions”**  
The test-user sits as “driver” in a workbench (simulating the FIAT test-car), while performing the test-tasks by interacting with the App using mainly the voice-based user interface.

#### **Usability Evaluation Methods Applied**

In Test-Setting 1, for Usability Evaluation of the graphical/touch user interface of the SIMPLI-CITY App, the well-established Usability Evaluation method “*Thinking Aloud Test*” is applied:

The test-user gets short tasks to do (such as e.g., “Show your next trip using car position and information from your agenda.”), and is asked to speak out loud all her/his thoughts

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 78 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

while using the SIMPLI-CITY system to complete the tasks. This helps the observer(s) to find out where and why usability problems occur.

In Test-Setting 2, when utilising the voice-based user interface, the Usability Evaluation method “*User Tests with Retrospective Probing*” is applied:

The test-user is provided with a concise description of a test-task, which she/he should complete by interacting with the system mainly via the voice-based user interface. The moderator silently watches the test-user’s activities, and does not intervene during the test. After completion of the test, the moderator asks the user to recapitulate and explain as detailed as possible from her/his point of view the steps taken and the problems and difficulties faced.

## Usability Evaluation – Step by Step

### **Step 1: Establish the Facilitators’ Team**

For the conduction of the Usability Evaluation a team of at least 3 people is necessary:

#### **1) Moderator:**

Role: she/he is the one, who interacts with the test-user

Tasks:

- before the test-session: set up the room and take care that it is nice and comfortable
- put a “do not disturb” sign on the door
- welcome the test-user
- introduce the team to the test-user
- explain the purpose of the test, and the procedure
- interview the test-user briefly (demographics/background questionnaire)
- ask the test-user to sign the Consent Form
- guide the test-user through the *Thinking Aloud Test*
- guide the test-user through the “simulated driving conditions” *Usability Test with Retrospective Probing*
- conduct the debriefing-interview with the test-user
- ask the test-user to fill-in the feedback questionnaire
- answer the test-user’s questions
- thank you and farewell to the test-user

#### **2) Technician:**

Role: she/he is the one, who takes care that all the technical equipment is working properly, and the recording is fine

Tasks:

- before the test-session: take care that all the equipment is in place (desks, chairs, lamp, test-Smartphone, workbench simulating the FIAT test-car, observer laptop, recording laptop, webcam mounted on tripod, ...)
- before the test-session: set up the SIMPLI-CITY system on the Smartphone, set up the workbench, and check that the system is working
- before the test-session: set up and check the system for audio and video recording

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 79 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

- before the test-session: set up and check the system for screen recording
- during the test-session: trouble shooting in case that any problems with the equipment or software occur
- during the test-session: act as “camera man” (start and stop recording, adjust camera position and audio set-up)
- during the test-session: start stopwatch, when the test-user starts with a test-task, and in case that the specified “termination condition” for a test-task is a maximum task time, notify the moderator when the “termination-time” for this specific task is reached
- after the test-session: take care to save the recordings, and prepare the equipment/programs for the next test-session

### 3) Observer(s) (one or more):

Role: she/he monitors the test-session, and takes notes of all usability issues that come up

Tasks:

- before the test-session: prepare and check equipment for taking notes (pen and paper, sticky notes, laptop,...)
- during the test-session: silently watch the test-user, and note down every usability issue that occurs
- during the test-session: note down any clarification questions, that you would like to be answered by the test-user after the test-sequence
- after the test-session: save your notes (and prepare for the next test-session)

### Step 2: Recruit Test-Users

The target group for the SIMPLI-CITY App “Eco Live Assistant” are car drivers, who own an Android Smartphone and want to use SIMPLI-CITY Apps for minimising the impact of their car trips on the environment.

In order to get useful results from the Usability Evaluation, the test-users should resemble this target group as good as possible.

Therefore the test-users shall have the following characteristics:

- familiar with using Apps on an Android Smartphone
- experienced in driving a car
- ideally: familiar with the workbench simulating a FIAT test-car
- good English language skills (applies to those, who are testing the English version of the App)
- good Italian language skills (applies to those, who are testing the Italian version of the App)

In addition, since the usability evaluation sessions will take place in Turin (IT), the test-users should

- be available for usability tests in Turin

Of course, the test-users should resemble the target group also with respect to demographic characteristics. However, since people, who own a Smartphone and want to minimise the impact of their car trips on the environment, do not have specific demographic characteristics such as e.g., a certain age or educational background, this is not a critical criterion for the selection of test-users.

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 80 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

Try to find at least 7-8 people, who fulfil the selection criteria stated above and are willing to act as test-user. A test-user will have to spend about 2 hours for the Usability Evaluation session. The test-users will not receive remuneration, but participating in the SIMPLI-CITY Usability Evaluation gives them the unique possibility to gain practical insights into state-of-the-art usability evaluation methodology and procedures.

From the 7-8 selected people, choose 1 as test-user for the pre-test, 5 as test-users for the regular Usability Evaluation sessions, and 1-2 for stand-by to replace a test-user in the Usability Evaluation sessions in case that one of the 5 cannot participate due to unforeseeable circumstances.

### **Step 3: Organise Equipment**

#### **Room / Test-Bench**

Reserve the test-bench for the Usability Evaluation sessions. You should make the reservation of the room not only for the 5 regular Usability Evaluation sessions (which will each take about 2 hours), but also for the pre-test and for the dry run. Furthermore, your room reservation should take into account that before each session about 30 minutes will be needed for preparing the set-up, and before leaving the room another 30 minutes should be scheduled for cleaning up.

The room does not need to be a usability testing lab, but it has to provide some specific features:

- it should be big enough to host 3-4 tables and chairs
- it should have a relatively sound-proof and non-transparent door
- it should allow you to control the sources of light in the room; to avoid glare there should be no source of light directly above the testing device
- it should provide enough air for 3-4 people to work therein with door closed
- it should provide a good cellular signal, good internet connectivity and enough socket-outlets

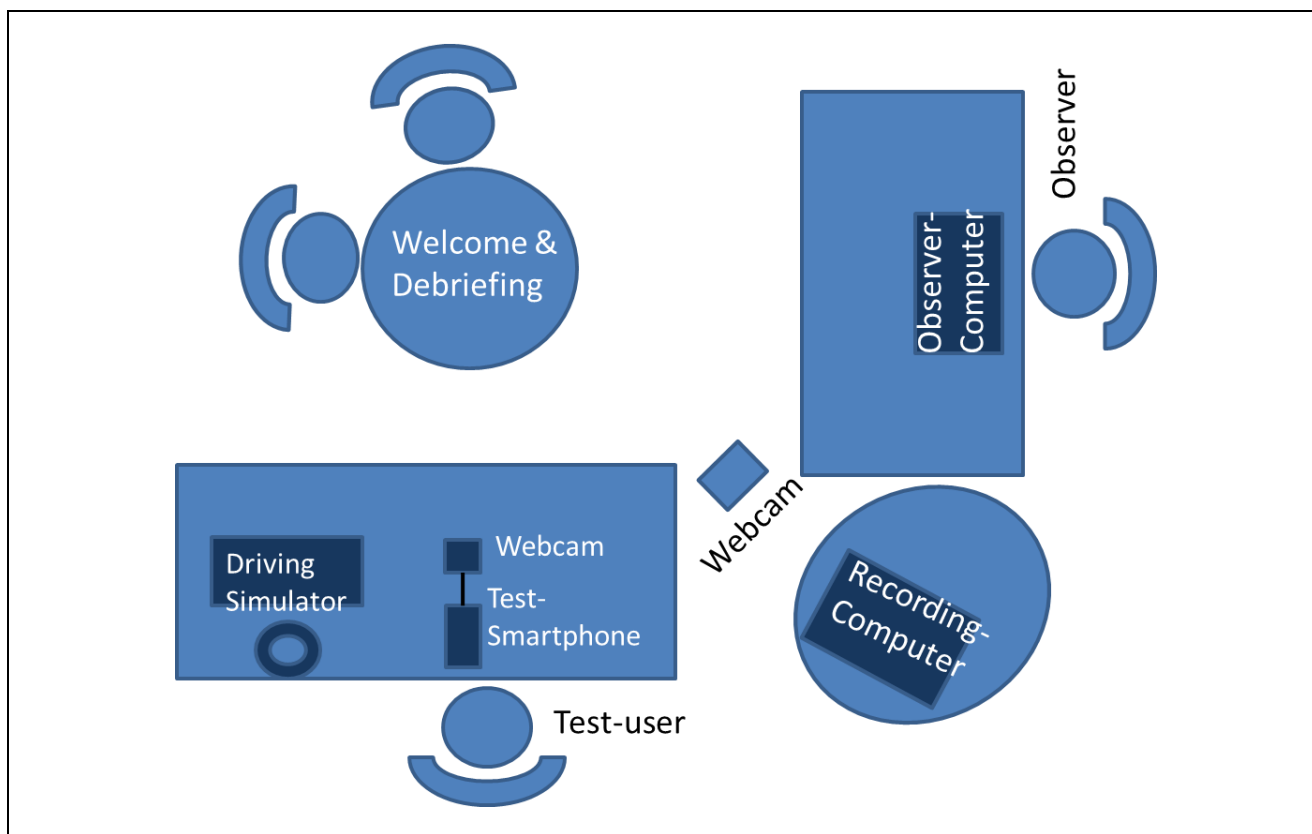


Figure 24: Example Room Set-up for Usability Evaluation Session

### ***Furniture and Gadgets***

Prepare the working place at the test-bench for the test-user, and a working place (table and chair) for the observer(s). In addition, a separate table with two chairs, where the moderator can make the introductory explanations and the debriefing interview with the test-user, is quite useful. Furthermore, also a place for the recording laptop is needed.

In the setting (as shown in Figure 24) the usability evaluation session is recorded with a camera that captures the whole scene, and puts a special focus on the voice and facial expressions of the test-user while doing the test-tasks. Another webcam is mounted on a rig attached to the test-smartphone, and captures the test-user's touch interaction with the smartphone.

It may be handy to have a stopwatch, so that it's easier to check during the test session, whether the "termination-time" for a test-task is already reached.

### ***Technical Equipment***

#### ***Test-Device:***

The test-user is to be provided with a NEXUS 4/5 Smartphone, to work with when doing the test-tasks. This Smartphone shall be mounted on a rig, which holds a webcam that captures the test-users touch-interaction with the Smartphone. The whole construction (rig + webcam) must be lightweight as to allow the test-user to hold the Smartphone (with the rig) in her/his hands and interact with the phone as she/he is used to. In the following figure an example of such a rig is shown: This example rig is constructed with Lego® elements. The webcam used is a Microsoft LifeCam HD-3000. The LG NEXUS 4 smartphone is mounted on the rig with rubber bands.

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 82 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

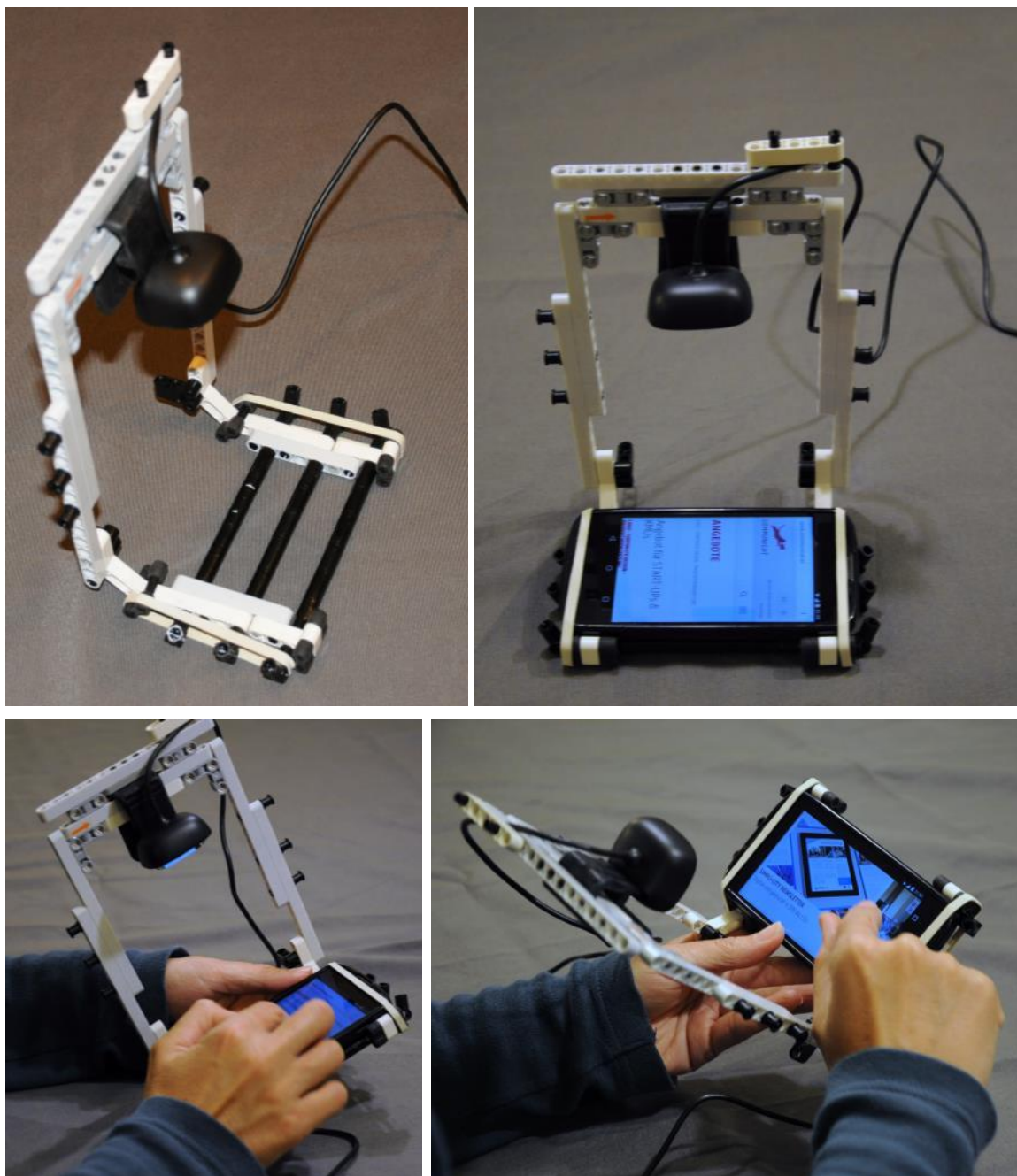


Figure 25: Example of a rig constructed with Lego® elements

#### *Computers:*

2-3 computers are needed to conduct the Usability Evaluation – one that is used for recording the session, one that the observer uses to take notes, and another computer (or just a second screen for the observer's computer) that allows the observer to simultaneously watch the video capturing the screen of the test-Smartphone and the fingers of the test-user. These computers can be PCs or laptops.

#### *Accessories for Computer and Smartphone:*

The test-user shall interact with the voice-based user interface of the App via a Bluetooth headset.

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 83 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

*Cameras and Microphones:*

The whole session needs to be recorded, in order to be able to analyse it in more detail afterwards, and in order to have some documentation for the evaluation report to illustrate and back up the results. Specifically the test-user's voice (and if possible also the test-user's facial expressions), as well as her/his fingers' interaction with the Smartphone have to be recorded while the test-user is performing the test-tasks. There should also be a voice-recording of the debriefing interview.

In total, 2 cameras are needed:

- It is recommended to use a webcam (or action cam) mounted on a tripod for the recording of the voice and the facial expressions of the test-user during the test in Test-Settings 1 ("laboratory conditions"), and for recording of the debriefing interview. Primary selection criteria for this camera should be the recording quality of sound (voice), but it should also allow for acceptable video recording quality. It should be taken into account that the camera needs to capture session durations of about 1.5 hours.
- Another webcam needs to be mounted on the rig that holds also the test-Smartphone. It should be suitable for capturing the screen of the Smartphone and the test-user's fingers, while interacting with the touch-screen during the test. This camera needs to be especially lightweight, in order to allow the test-user to hold the rig with the camera and the Smartphone in the hand and interact with the phone as she/he is used to.

**Software***Software to be tested:*

Usability Evaluation will look at SIMPLI-CITY's App "Eco Live Assistant" from road-user's point of view. Thus, on the test-Smartphone all software, which is needed to make proper use of the SIMPLI-CITY App, should be installed.

*Recording Software:*

The recording computer should be equipped with software for recording and playback of the audio- and video files captured by the cameras (e.g., VLC media player).

The videos of the two cameras should be displayed in two windows in parallel on the recording computer's screen, and this combined vision should be captured with screen recording software to be stored for later analysis, and at the same time also displayed at the observer's computer. For this task either professional usability evaluation software (e.g., Morae by TechSmith) or free screen recording software (e.g., CamStudio), or screen-sharing/video-conference tools (e.g., GoToMeeting by Citrix, or TeamViewer) can be used.

**Step 4: Plan Timeline**

preparatory work  
(establish facilitators team, recruit test users, book room and workbench, organise equipment, ...)

↓ (do this as early as possible to ensure that test-users can block the date in their calendar...)

dry run  
(plan enough time for that, it will probably take half a day to get everything working...)

↓ (it's wise to plan 1 week for taking into account lessons learnt during dry run...)

pre-test  
(will take about 2.5 hours...)

↓ (it's wise to plan 2-3 days for taking into account lessons learnt from pre-test...)

usability evaluation sessions  
(plan these on 2-3 subsequent days, and calculate about 2 hours for each of the 5 sessions and about 30 minutes break between any two sessions ...)

↓ (start immediately after the usability evaluation sessions with analysis and summary work – it's much easier when the impressions are still "fresh"...)

evaluation report  
deliver "evaluation report" as early as possible (by end of August at the very latest!)

**Step 5: Agree Upon the Test-Session Design**

A Usability Evaluation Session should take no longer than about 1.5 hours. Therefore, due to time constraints, it will most probably not be possible to run through the whole set of test-tasks in each of the two test-settings. It is recommended to let the test-user do all test-tasks in the first test-setting ("laboratory conditions"), and to select only a digest of test-tasks for test-setting 2 ("simulated driving conditions").

Thus, the facilitators' team should agree upon an (initial) task-list for each of the test-settings.

**Step 6: Conduct Dry Run**

When you have got all the necessary equipment and software, make a dry run: set-up the room, the work bench, and the equipment for the Usability Evaluation session, ask a colleague to act as test-user, and go through the whole session. Thereby you should check:

- Is any part of the equipment missing?
- Is the equipment working as expected?
- Is it possible to complete all test-tasks?

- How long does each test-task take (approximately)?
- How long does the complete session take (approximately)?
- What's the best way for taking notes?
- Are the recordings o.k.?
- What's the best way for analysing the recordings?

As an important result of the experience from the dry run, you should refine the test-session design and accordingly adapt the list of test-tasks chosen for each of the two test-settings.

### **Step 7: Prepare Material**

Prepare the following material for the Usability Evaluation sessions:

- *“Do Not Disturb” Sign*, to be put on the test-room's door
- *Consent Form*, which has to be signed by the test-user to state that she/he agrees with the voice and video recordings of the session
- *Short demographics/background questionnaire*, to be asked to the test-user at the beginning of the session
- *Task Sheets*, briefly describing each test-task, to be given to the test-user
- *Detailed Task Sheets* describing each test-task in more detail and also stating the completion-condition as well as the termination-condition for each test-task, to be given to the moderator, technician, and observer(s)
- *Briefing Notes* for the observer(s)
- *Cheat Sheet* for the moderator
- *Feedback Questionnaire*, to be filled in by the test-user after the test
- 2-3 ballpoint pens, pad of paper, sticky notes

### **Step 8: Conduct Pre-Test**

About 2-3 days before you've scheduled the first Usability Evaluation session, you should conduct a pre-test with one of the test-users that you've recruited. Take this pre-test seriously and conduct it the same way that you've planned to conduct the Usability Evaluation session. This pre-test allows finding out, whether or not

- the overall session concept works out as expected,
- the time planned for each task and for the overall session is realistic,
- the explanations given to the test-user are sufficient or need more details

Adapt the session concept, the set-up, and the material according to the lessons learnt during the pre-test.

### **Step 9: Conduct Test-Session(s)**

#### **Step 9a: Preparation:**

On the day before the first test-session is scheduled, double check the equipment and ensure that the batteries of the mobile phone, the cameras, and the headset are fully charged.

Before the start of the test-session is scheduled, take about 30 minutes for preparatory work:

- set-up room, work bench, and equipment

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 86 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

- boot computers and Smartphone, and start necessary programmes
- final check to ensure that everything is working properly
- put “Do not Disturb” sign onto the door

### **Step 9b: General Introduction:**

The moderator welcomes the test-user, and

- introduces the facilitator-team to the test-user
- explains the purpose of the session, the role of the test-user, and the process that will be followed in the session
- asks the test-user the questions included in the *Introduction Questionnaire*
- asks the test-user to sign the *Consent Form*

### **Step 9c: Introduction to Test-Setting 1:**

- The moderator explains the Thinking Aloud method and demonstrates it with an example task<sup>11</sup>

Note: the example demonstration should be given using another user interface (not the one to be tested!)

A possible example task, for demonstrating how the Thinking Aloud method works, would e.g., be: “*Start the SIMPLI-CITY Information App and find out how many partners work for the SIMPLI-CITY project*”

- The moderator asks the test-user to take some minutes to familiarise with the test-Smartphone and the work-place
- The moderator asks, if the test-user has any further questions and explains that the test-user may also ask questions during the Thinking Aloud Test, but these may only be answered after the test

### **Step 9d: Thinking Aloud Test:**

This part of the session shall be recorded (audio, video, and screen recording), and the screen recording of the two videos shall also be displayed on the observer’s computer.

Note: In this test-setting the audio recording and the screen recording are the most important parts as they will be used for detailed analysis of the usability issues after the test session. The video recording of the test-user’s face is not absolutely necessary for the analysis of usability issues, but it supports this task, as the facial expressions of the user show her/his emotions more clearly and indicate e.g., if the test-user finds a task cumbersome.

The moderator asks the test-user to do one task after the other (starting with an easy “warm-up” task), whereby the sequence of the steps is the same for each task:

1. the moderator gives the test-user the task-sheet, and asks the test-user to read out loud the task description
2. after the test-user has read the task description, the moderator asks, if the task is clear or any further clarifications are needed

<sup>11</sup> alternatively to demonstrating the Thinking Aloud method on-site with an example task, the moderator could also show a short video (no longer than about 1 minute), such as e.g., the demo-video that Jacob Nielsen introduces in his article “Demonstrate Thinking Aloud by Showing Users a Video” <http://www.nngroup.com/articles/thinking-aloud-demo-video/>, or part of the “UserTesting Panel Team” video recorded during a usability test <https://www.youtube.com/watch?v=m9D1suUiZjo>

3. if everything is clear, the moderator tells the test-user to start with the task, to “think aloud” while doing the task, and to state when the task is completed. While the test-user is working on the task:
  - a. the test-user speaks out loud her/his thoughts and considerations, while working with the system and striving to complete the task
  - b. the observer takes notes of all usability issues that become apparent, and also writes down any questions that should be asked to the test-user for clarification, afterwards
  - c. the technician takes care for the recordings (screen recording of the test-user computer, audio recording of the test-user’s voice, video recording of the test-user’s facial expressions)
  - d. the moderator watches the test-user silently, and takes notes of any questions of the test-user (to be able to answer these questions after the test); if the test-user stops “thinking aloud” the moderator reminds her/him to continue with expressing her/his thoughts
4. when the test-user indicates that the task is completed, or when the termination-condition (e.g., agreed termination-time) is reached, the moderator asks the test-user to fill in the *Single Ease Question* (SEQ) stated on the task-sheet, thanks the test-user for the effort spent on this task, and gives her/him the task-sheet for the next test-task.

#### **Step 9e: Debriefing Interview:**

This part of the session shall also be recorded (at least audio recording) in order to facilitate analysis and reporting.

The first question that the moderator should ask the test-user after the Thinking Aloud Test is: “How was it?”

Only after the test-user has finished talking, the moderator shall ask further questions (e.g., those clarification requests noted down by the observer during the test) and answer also those questions that have been asked by the test-user during the Thinking Aloud Test.

#### **Step 9f: Introduction to Test-Setting 2:**

- The moderator explains the “simulated driving conditions” test-setting, and how this usability test will work
- The moderator briefly explains and demonstrates the voice-based interface of the PMA
- The moderator asks, if the test-user has any further questions, and explains that the test-user may also ask questions during the test, but these may only be answered after the test.

#### **Step 9g: Usability Evaluation with Simulated Driving Conditions:**

This part of the session shall be recorded (audio and video), and the video shall also be displayed on the observer’s computer.

Note: In this test-setting, besides the audio recording also the video recording of the test-user’s face is especially important, since after the test session this video recording will not only help to analyse usability issues in detail (as already explained for test-session 1), but in addition this video will also be analysed to estimate the

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 88 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

“head down” time, i.e., the time the test-user spent looking at the Smartphone instead of looking at the road.

The moderator asks the test-user to do one task after the other (starting with an easy “warm-up” task), whereby the sequence of the steps is the same for each task:

1. the moderator gives the test-user the task-sheet, and asks the test-user to read out loud the task description
2. after the test-user has read the task description, the moderator asks, if the task is clear or any further clarifications are needed
3. if everything is clear, the moderator tells the test-user to pretend driving the car and do the test-task in parallel. The test-user is also asked to state when the task is completed. While the test-user is working on the task:
  - a. the observer takes notes of all usability issues that become apparent, and also writes down any questions that should be asked to the test-user for clarification, afterwards
  - b. the technician takes care for the recordings (audio recording of the test-user’s voice, video recording of the test-user’s eyes and facial expressions)
  - c. the moderator watches the test-user silently, and takes notes of any questions of the test-user (to be able to answer these questions after the test), and also writes down all questions that afterwards should be asked to the test-user for clarification
4. when the test-user indicates that the task is completed, or when the termination-condition (e.g., agreed termination-time) is reached, the moderator asks the test-user to answer the *Single Ease Question* (SEQ) stated on the task-sheet, thanks the test-user for the effort spent on this task, and asks the test-user: “How was it?”
5. Only after the test-user has finished talking, the moderator shall ask further questions (e.g., those clarification requests noted down by the observer(s) and by the moderator during the test).
6. After this feedback round, the moderator moves on and gives the task-sheet for the next test-task to the test-user.

### **Step 9h: Debriefing Interview:**

This final feedback round shall also be recorded (at least audio recording) in order to facilitate analysis and reporting.

The first question that the moderator should ask the test-user is: “What did you like best about the App?”

Only after the test-user has finished talking, the moderator should ask: “What were the main difficulties, when completing the tasks?”

After this round of open questions and answers, the moderator hands over to the test-user the printed feedback questionnaire (standardised *System Usability Scale* (SUS), and asks the test-user to fill it in.

### **Step 9i: Farewell:**

When all questions have been answered and the feedback-questionnaire is filled-in, the moderator thanks the test-user for her/his contribution, and accompanies her/him to the door.

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 89 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

**Step 9j: Post-processing:**

Immediately after each Usability Evaluation session

- the technician shall take care that all recordings are saved, and the recording equipment and the Smartphone are prepared for the next session
- the observer shall save her/his notes, and prepare her/his working place for the next session
- the moderator shall prepare the room and the material for the next session

**Step 10: Report the Results**

It is strongly advised to start with the analysis, and summary of the results of the Usability Evaluation sessions as soon as possible after conducting the sessions, since it is much easier when the impressions of the sessions are still “fresh” in mind. Analyse the observer’s notes and the session recordings in order to find out the most important positive aspects and the most important usability issues revealed by the Usability Evaluation sessions.

Summarise these findings, and illustrate with screenshots, and quotes from the test-users.

Important: Do not use the test-users’ real names in the reporting, but use pseudonyms instead.

In addition to these qualitative findings, the report should also contain quantitative measures, such as e.g. rate of task completion (for all test-settings), and “head-down” time (for the tasks to be done during “driving” in test-setting 2).

**Checklist for Usability Evaluation of the SIMPLI-CITY App**

- ☐ establish facilitators-team and assign roles for team-members
- ☐ agree timeline with the team (define date for dry run, pre-test, and usability evaluation sessions)
- ☐ recruit participants (allow 2-3 weeks for this process)
- ☐ reserve room and organise car and equipment
- ☐ setup Smartphone and computers (select, install and check software)
- ☐ assemble material for facilitators-team (briefing notes, detailed test-tasks list,...)
- ☐ assemble material for participants
- ☐ set up testing environment
- ☐ print copies of material
- ☐ conduct dry run (at least 1-2 weeks before scheduled test sessions)
- ☐ adjust concept, and material according to lessons learnt from dry run
- ☐ conduct pre-test (at least 2-3 days before scheduled test sessions)
- ☐ adjust concept and material according to lessons learnt from pre-test
- ☐ send out reminder emails to test participants (1-2 days before scheduled test sessions)

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 90 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

- ☐ conduct usability evaluation sessions
- ☐ debrief with team after each session and capture key positive findings and usability issues on an issue tracking spreadsheet
- ☐ send thank you notes to test participants
- ☐ analyse notes and recordings and determine final list of positive findings and usability issues
- ☐ analyse video recording of test-sessions 2 in order to find out the “head down times”
- ☐ work with team to develop recommendations for improvement
- ☐ prepare summary of findings and structured evaluation report

# Annex E: Moderator Cheat Sheet for Usability Evaluation

## Moderator Cheat Sheet

### Material:

- **2-3 pencils, notepad, sticky notes**
- **Printed Material:**

1. **Consent Form** (2 copies)  
(one shall be signed by the test-user, the second one is to be given to the test-user)
2. **Introduction Questionnaire**  
(to be filled-in by the moderator according to the answers of the test-user)
3. **Task Sheet for the example task**  
(moderator uses it for demonstrating the “Thinking Aloud” method)
4. **Task Sheets for the test-tasks**  
(one sheet per test-task; to be given to the test-user one by one)
5. **Feedback Questionnaire**  
(to be filled-in by the test-user)

### General Rules:

- Treat participants with respect and make them feel comfortable
- Remember that you are testing the system not the users. Help them understanding that they are helping us testing the prototype
- Remain neutral – you are there to listen and watch. If the participant asks a question, reply with “What do you think?” or “I am interested in what you would do”
- Do not jump in and help participants immediately and do not lead the participant. If the participant gives up and asks for help, you must decide whether to end the scenario, give a hint, or give more substantial help.  
*The team should decide how much of a hint you will give and how long you will allow the participants to work on a scenario when they are clearly going down an unproductive path.*
- In a “Thinking Aloud Test”: if a participant stops talking, prompt neutral with “Please think aloud” or “What are you thinking?”

## Conducting the Usability Session – Step-by-Step:

### Step 1) Introduction:

#### Orientation Script for the introduction:

[Welcome the test-user at the door, and introduce the team]

*Hello, John. Thank you that you have agreed to help us. My name is Michaela. I will be working with you here today. This is Rosty, he will take care that all the technical equipment is working properly. And this is Philipp, he will help me with taking notes.*

[Guide the test-user to the “interview table”, make her/him feel comfortable, and explain the purpose of the test-session]

*Please take a seat, and have a drink and some sweets.*

*We are here to test the SIMPLI-CITY system, which aims to support road users.*

*For this we need your help. I will ask you to perform some typical tasks with the SIMPLI-CITY system. However, you need not be worried: we are testing the system and not your performance! Since the system is still under development, it is not perfect and will most probably have some bugs and things may not work exactly as you expect.*

*So we are here to discover the flaws and advantages of this system from your perspective. Therefore it is really important that you do not act or say things based on what you think that we might want to see or hear. We need to know what you really think.*

*In order to be able to better follow your trail of thoughts during the test, for some parts of the test we will ask you to think aloud while you work. Of course you can ask questions at any time, but I may only answer them at the end of the session.*

*While you are working, we will take notes. We will also record the session so that we can analyse the findings of today in more detail afterwards.*

*If you feel uncomfortable, you can make a break or stop the test at any time.*

*Do you have any questions?*

[→ Answer questions, if any]

*O.k., then let's begin by filling out a short background questionnaire and having you sign the consent form.*

### Step 2) Signature of the Consent Form

Give the test-user 2 copies of the consent form and ask her/him to sign one, which you should keep. The test-user gets the second copy for her/his records.

### Step 3) Background Questionnaire

Ask the test user the questions from the “Introduction Questionnaire”, and fill in the test-user’s answers into the questionnaire.

D8.3_Evaluation_Report_v1.0_For_Approval.docx	Document Version: 1.0	Date: 2015-10-30	Status: For Approval	Page: 93 / 96
<a href="http://www.simpli-city.eu/">http://www.simpli-city.eu/</a>		Copyright © SIMPLI-CITY Project Consortium. All Rights Reserved. Grant Agreement No.: 318201		

#### Step 4) Setting 1: Explanation of the Session's Workflow and of the Thinking Aloud Method

- Orientation Script for the introduction:  
*As already explained, I will ask you to complete some tasks, and in this first part of the session I will ask you to “think aloud”, while you are working on the tasks. You should speak out all your thoughts and considerations. This helps us to better understand the motivation of your actions and makes it easier to reveal any issues with the system. - I will show you, what I mean by “thinking aloud”.*
- [Move over to the test-user's workplace, show the Task Sheet of the example task, and demonstrate how to “think aloud” while working on the example task.]
- *Do you have any questions?* [Answer questions, if any]
- *If not, let's start.*

#### Step 5) Ask Test-User to complete the Test-Tasks

- Give the “Task Sheet” to the test-user, and ask her/him to read the task loud.
  - Ask the test-user, whether she/he has got any questions.
  - [Answer the test-user's questions, if any]
  - Ask the test-user to start with the test-task, remind her/him to “think loud”, and ask her/him to notify you, when she/he has completed the task
- [
- While the test-user is working on the task, keep silent and carefully watch the test user; take notes of any questions the test-user asks while working on the test, so that you can answer these questions later;  
take notes of any questions that you would like to ask the test-user later;
- ]
- When the termination-criterion is reached, and the test-user seems not to be able to finish the task within the next minutes, interrupt the test-user and ask her/him to answer the question on the “Task Sheet”.
  - When the test-user has finished the task, ask her/him to answer the question on the “Task Sheet”.
  - Thank the test-user for the effort that she/he has spent on the task, and give the next “Task Sheet” to the test-user.
  - After finishing the last test-task, inform the test-user that this was the last test-task for the first part of the session

#### Step 6) Debriefing Interview for Test-Setting 1

- Ask the test-user: “How was it?” and let her/him talk
  - When the test-user has stopped talking, ask further questions [ask any questions, which you or the observer have noted during the session], and answer the test-user's questions that she/he might have asked during the Thinking Aloud Test.

### Step 7) Test-Setting 2: Simulated Driving Conditions

- Orientation Script for the introduction:  
*Let's start now with the second part of the session. I will again ask you to complete some tasks, as you already are familiar with. But this time you should pretend driving a car while you are working on the tasks. You do not need to "Think Aloud", but instead you should concentrate on driving, keep your eyes on the street, and interact with the Smartphone mainly via voice commands.*
- [Demonstrate to the test-user, how the voice-based interface of the App works.]
- *Do you have any questions?* [Answer questions, if any]
- *If not, let's start.*

### Step 8) Ask Test-User to complete the Test-Tasks that you've selected for Test-Setting 2

- Give the "Task Sheet" to the test-user, and ask her/him to read the task loud.
- Ask the test-user, whether she/he has got any questions.
- [Answer the test-user's questions, if any]
- Ask the test-user to start with the test-task, remind her/him to pretend to be the driver of the car and to concentrate on the street, and ask her/him to notify you, when she/he has completed the task

[While the test-user is working on the task, keep silent and carefully watch the test user; take notes of any questions the test-user asks while working on the test, so that you can answer these questions later;

take notes of any questions that you would like to ask the test-user later;]

- When the termination-criterion is reached, and the test-user seems not to be able to finish the task within the next minutes, interrupt the test-user and ask her/him to answer the question on the "Task Sheet".
- When the test-user has finished the task, ask her/him to answer the question on the "Task Sheet".
- Thank the test-user for the effort that she/he has spent on the task, and ask her/him "How was it?"
- Only after the test-user has finished talking, ask further questions (e.g., any clarification requests noted down by the observer or by yourself during the test).
- After this feedback-round, give the next "Task Sheet" to the test-user.
- After finishing the last test-task, inform the test-user that this was the last test-task, and ask her/him to move over to the other table ("interview-table").

### Step 9) Debriefing Interview

- Ask the test-user:
  1. "What did you like best about the App?"
  2. "What were the main difficulties, when completing the tasks?"
  3. "If you would be the developer of this App, what would you improve?"

### Step 10) Feedback Questionnaire

- Hand over the Feedback Questionnaire (System Usability Scale) and a pencil to the test-user, and ask her/him to fill-in the questionnaire.

### Step 11) Thank you and Farewell to the test-user

- Ask the test-user, whether she/he has got any further questions.  
[Answer the test-user's questions, if any]
- Thank the test-user for her/his effort and helpful cooperation.
- Show the test-user out.

### *Prepare room/vehicle and material for the next usability evaluation session*