

CHALMERS



Corporate Interaction Design for Mobile Devices

Development of Graphical User Interface Guidelines for mobile devices through the design of a smartphone application.

Master of Science Thesis in Industrial Design Engineering

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Division of Design & Human factors
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Cover: Illustrations of the main screens of the room-finder application.

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ABSTRACT

The project was performed in cooperation with Volvo Car Corporation in Gothenburg. Participating in meetings is a frequent activity for employees, but many experience problems with the current booking systems. As most employees possess a smartphone, it was suggested that an application could be designed to facilitate the action of booking a meeting.

VROOM, as the old room-booking system is called, offers the user the benefit of filtering through a large amount of rooms to find a suitable option, however, it is not synced with the user's calendar which means that a meeting has to be scheduled in two separate systems. Microsoft Outlook is the other system and it works together with the calendar to find a suitable time for the meeting, but the user can only filter the search based on time and building, which is not considered sufficient. As a result, both systems are used in certain buildings where the opportunity to filter searches is important. Therefore, a graphical user interface for a smartphone application that will complement the Outlook system was designed in this project.

The IT-department expects that several different smartphone applications for internal use will be needed in the future and a common design of these is desired. Therefore, the design of the final concept application was used to formulate design guidelines as there are currently no such document for mobile applications. This document also takes into consideration the Brand digital guidelines provided for web-interfaces used on computers.

Extracting user requirements and evaluating usability has been considered important for quite some time now, but there are no clear instructions as to how it is to be done. Therefore, development guidelines describing methods used in the project were formulated to aid in the research phase of future projects. Examples of the results from the project are included to describe how to implement the methods and what the expected outcome is.

The results from the project include a final design of a smartphone application for finding available rooms and booking meetings, represented by illustrations and descriptions of underlying functionality. A document describing appropriate methods for extracting user requirements was formulated and is to be used as part of the departments method library in future projects. Finally, design guidelines for future smartphone applications to ensure a cohesive expression were formulated from the design of the concept.

Keywords: Interface design, Design guidelines, user-centred design, smartphone application, user requirements methods.

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1 INTRODUCTION

Smartphones have become an important companion for most people in both personal and professional contexts. Certain companies have decided to provide their staff with a specific model, while others apply the concept of Bring Your Own Device (BOYD). Applications for smartphones are created to perform specific functions in a quicker way than using the website of the same service. As smartphone applications are meant to be quicker than the regular interaction, they need to be intuitive and attractive so that the users want to download and spread them to others. Therefore, human-machine interaction and interface design is extremely important for companies that desire their applications to be successful.

Volvo Car Corporation at Torslanda have previously stated that their user interfaces should have a high level of usability, but have realised that they need more specific methods to extract user requirements during development projects. The method library in place has yet to contain any of this kind.

It has also been discovered that different offices around the world have begun to create smartphone application for specific functions without involvement of the head office. Therefore, the applications have no common expression, which is a serious problem for a company as well known as Volvo Cars.

1.1 BACKGROUND

This project is performed in order to specify a way of working when developing future smartphone solutions for internal use. This will then be exemplified through the graphical construction of an application that enables staff to efficiently book rooms and resources via their smartphone.

The company currently uses two different systems depending on which building you want to book a room in, VROOM and Microsoft Outlook, but the aim is to eliminate the need of VROOM. Therefore, an application that enables simple booking using smartphones synchronised with the Outlook system is to be created to encourage the change of system. It is currently possible to book rooms in your smartphone, but it is quite complicated and not used. There is also a need to create a template on how to systematically develop smartphone applications for internal use. This template has to consider how to apply working methods to allow for good usability in the interface, but also how to apply Volvo Cars' brand statement "Designed Around You" and the graphical profile.

The results from this thesis project have to have a high degree of realisability as the application is to be used as soon as possible, and the guide is meant to be used by the staff working there today. However, the template also needs to be innovative enough to enable people to use it in the next few years as well.

1.1.1 THE COMPANY

Volvo Car Corporation was founded in 1927 in Gothenburg, Sweden. The head office, where this project was performed, is located at Torslanda, which is also one of the largest production sites. Volvo Cars has put focus on four core values; quality, design, environment and security. A new corporate strategy was recently adopted, including the brand statement “Designed Around You”. This is meant to set Volvo Cars apart from the competition by focusing on the owners’ experience by creating high end cars that understand people.

1.1.2 THE SYSTEMS

There are currently two systems in use for booking of rooms and resources. The first one, Microsoft Outlook, is the most recently adopted and incorporates the ability to book a room with the regular functionality of e-mailing and planning through calendars. One can therefore invite other participants to the meeting directly in the booking menu, and the meeting is scheduled in all participants’ calendars automatically. Volvo Cars started using this system during the summer of 2012, so it is a quite recent change. However, not all buildings at Torslanda have transitioned yet. Some buildings still use the old booking system – VROOM – which is purely meant for booking rooms and equipment such as projectors, phones, etc. VROOM is not incorporated with other systems, so invitations to meetings and synchronising with one’s personal calendar needs to be performed in a separate system. Before VROOM was created in 2001, the staff used paper lists and pencils hanging by each room for booking.

1.2 AIM

The aim of this project is to construct a template for how to make use of certain methods when developing smartphone applications for internal use, this template will be exemplified through the creation of a graphical booking application interface. This is done as there are currently no guiding principles for designing interfaces for smartphones and there is a desire to make internal applications cohesive throughout the organisation.

The template is meant to be used by business analysts and developers at Volvo Cars’ IT department who have some knowledge of working with users, but are mostly focused on the functional part of applications. The booking-application is meant to be used by the entire body of staff at Volvo Car Corporation.

1.3 DELIVERABLES

After this project has been finished, the results will be used in the development of several new applications besides the booking application. Therefore, the project has three main deliverables.

- The results should include a clearly formulated guide on how to make use of certain methods when developing applications, which is implemented and explained through the development of the booking-application.
- Design guidelines that show features that are to be common in future applications will be specified. This document will be used by designers and developers to ensure a cohesive expression among internal Volvo Cars applications.
- How to apply the information in these two documents will be exemplified through the design of a room-booking application which is to be specified using illustrations and aiding text that describes the interaction.

1.4 REPORT DISPOSITION

The report is structured to follow the development process of the smartphone application in a clear and structured way. The content of each chapter is described below.

- Chapter 2 – Theory and Methods: The selected methods, tools and theories used in this project are summarised.
- Chapter 3 - Implementation: This chapter describes the different activities of the project briefly and how the methods chosen have been implemented. An illustration of the process will also be presented.
- Chapter 4 – System research: The first activity of this project consists of an investigation of the current systems in order to understand the main functions and discover potential usability problems.
- Chapter 5 – User study: This chapter of the report describes the investigation of the users of the systems and what their goals and desires are.
- Chapter 6 – Visual elements design describes the different graphical guidelines that are taken into consideration for the requirements and the final design concepts.
- Chapter 7 – Goal formulation: In this chapter, the goals of the booking-application concept are defined.
- Chapter 8 – Requirements specification describes the requirements and guidelines worked out through the previous activities.
- Chapter 9 – User interface development guidelines: The main methods used in the previous research phase are described in the user interface development guidelines so that business analysts and developers involved in future application development projects can extract user requirements more efficiently.
- Chapter 10 – Concept development: In this chapter, the concept development process and the basic navigation concepts are described and motivated. The concepts are formulated with respect to two aspects; structure/navigation and aesthetics.
- Chapter 11 – Concept evaluation: The three navigation concepts and the different icon suggestions were evaluated in several ways to be able to sort out to form a final concept.
- Chapter 12 – Final concept: After the concept evaluation, the final concept was developed from the best aspects. Features such as navigation, icons and functions are described in depth.
- Chapter 13 – Final concept evaluation: A final evaluation of the finished graphical user interface was performed in order to compare it with the reference interfaces.
- Chapter 14 – Graphical user interface design guidelines: This chapter describes the formulation of the graphical design features that are described in the Graphical user interface design guidelines.
- Chapter 15 - Discussion: The discussion is divided into five sections that handle the topics: results, process, methods, sustainability aspects and future development.
- Chapter 16 - Conclusion: Finally, the conclusion summarises the author's thoughts concerning the project as a whole.

2 THEORY AND METHODS

The selected methods, tools and theories used in this project are summarised in the following chapter.

2.1 THEORY

The theory used in this project concerns the human-machine interaction through interfaces and how to make use of interface design guidelines to make this interaction as efficient and pleasurable as possible.

2.1.1 HUMAN-MACHINE INTERACTION

The cognitive theory concerning human-machine interaction has a central place in this project as it describes the mental processes of the user and how to optimise the usage of an interface.

Mental models

“In interacting with the environment, with others, and with the artefacts of technology, people form internal, mental models of themselves and of the things with which they are interacting. These models provide predictive and explanatory power for understanding the interaction.” (Norman, 1983)

A user’s mental model of a system is an internal representation of the system. It describes important functions and features that are stored in the memory. These models can be used by designers to structure the system so it becomes easy to understand for the user, as they can easily imagine how the system is built up and how to navigate in it (Bligård, 2012).

The representation model is created by the designer to match the mental model of the user. This model is a description of how the system works, but it should be described in a way the user understands. A good representation model is e.g. the brake pedal in a car; the driver imagines something pushing down on the wheel to slow it down, but in reality, the process is much more advanced. (Cooper et al. 2007)

Mental models can also be used to predict how a user will interact with a system, based on similar systems and previous experiences. They can simplify behaviour so one has the possibility to compare different users’ behaviour. However, if the user already has a mental model of how the system should work before having used it, there can be problems if the system is not built up as expected. One should therefore consider the risks when not designing according to convention. (Richardson & Ball, 2009)

When interacting with a system, a mental model can be created spontaneously based on the first impression, but it can also be created through training if one approaches the system in

a structured way from the beginning. Both types can be correct so it depends on what type of system it is and what resources are available for training. (Bligård, 2012)

Cognitive ergonomics

The mental workload on the user has a significant impact on the performance and the individual differences in mental resources are large. The mental effort is affected by several internal factors, e.g. the complexity of the task, multitasking, prior understanding and experience, as well as performance shaping factors such as stress, environment and time constraints. It is therefore important to consider the holistic view of the situation when designing an interface. (Bligård, 2012)

Perception describes how a person detects stimuli through the senses, processes that information and then makes a decision and acts on it. It begins with the detection of the stimuli by the senses, which then needs to register and categorise it through perception. Information required to do this is retrieved from the long-term memory if it is something that has been experienced before. The decision of how to act on the stimuli is made through the knowledge of previous experience or what has been instructed in connection with the stimuli (information gathered from the short-term memory). Finally, the response is executed and feedback concerning this is perceived through stimuli (Wickens et al. 2004). Figure 1 illustrates this process.

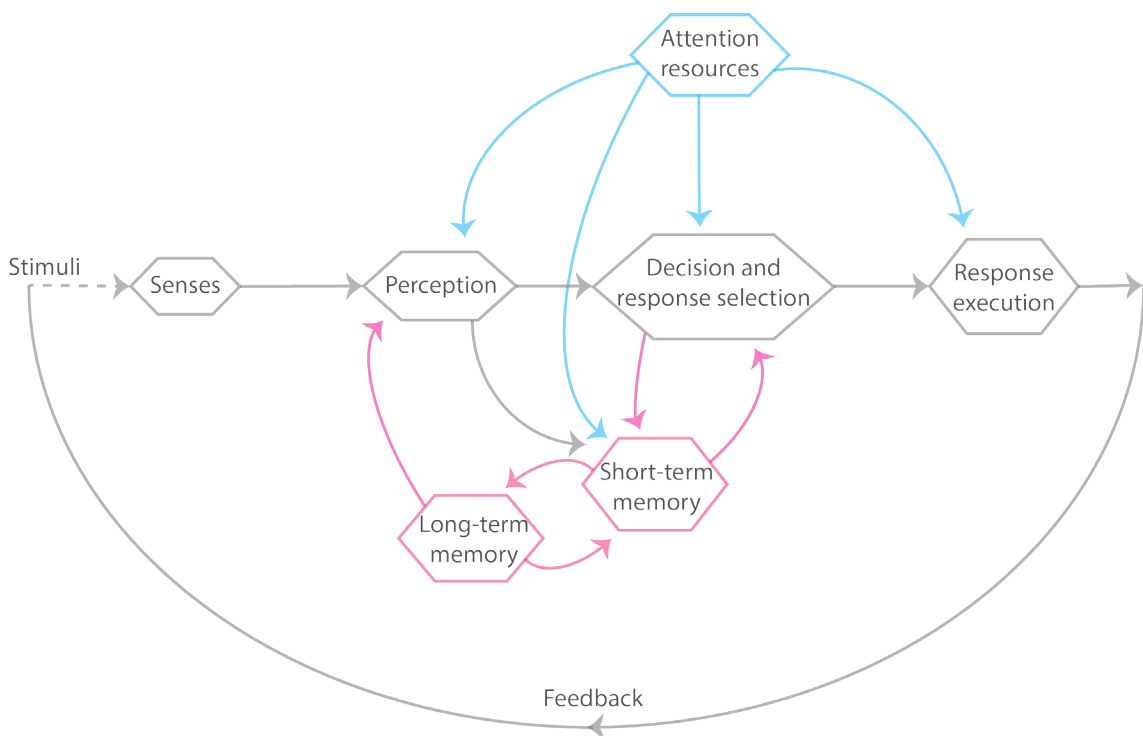


Figure 1. Illustration of the human information processing model.

It is important not to put strain on the short-term memory by making the user remember a large quantity of information in order to complete a task. The attention resources are also limited, therefore, one should make sure that necessary information is readily available and choices to act can be made with relevant material fresh in mind. (Wickens et al. 2004)

2.1.2 INTERFACE DESIGN

Several theories and studies concerning Interface Design were collected and a summation of the most suitable are presented in this section.

Design for attention, perception, memory and mental models

Bohgard et al. (2008) presents a set of guidelines to support the user's attention resources, perception, memory and mental models.

Supporting attention:

- Minimise time and effort to find information by reducing the number of menus and displays.
- Things that relate should be placed close to each other or be given a theme or colour. But be careful not to make it messy and too colourful.
- Use multiple sources of information by e.g. making some information visual and other audial.

Supporting perception:

- Displays should have good readability through e.g. high contrast, good lighting and text size.
- Avoid using many different text sizes and colours on a limited space as it becomes confusing.
- Only bottom-up processing should be avoided. Any event that is not expected should be enforced to make the user interpret it faster.
- Redundancy should be used to speed up information processing.
- Avoid similarities in objects and icons. Identification numbers like AJB648 and AJB658 should be simplified to e.g. 48 and 58 to avoid confusion.

Supporting memory:

- No important information should have to be stored in the short-term memory. Most individuals find it difficult to remember more than 7 ± 2 units simultaneously, so information required to perform a task should be readily available. However, too much information can be confusing.
- Expert users like to be able to use shortcuts. (Norman, 1988)
- Predicting the system's status is highly demanding so it is best to have a system that can describe its expected status depending on current data.
- It is most often beneficial to design the new interface to be consistent to the old one to facilitate learning for the users who have handled the old one. Especially colours representing important functions should be preserved.

Supporting mental models:

- Elements in the interface should be made as representation of reality to allow for quicker interpretation by e.g. showing temperature as a vertical thermometer.
- Dynamic images can be used to show movements, e.g. material flow through a process, in a way that is similar to reality.

10 Design Guidelines for Search User Interfaces

The following 10 guidelines by Wilson (2011) are based on the principles presented by Nielsen et al. (1994). They are appropriate to consider when designing an interface based on a need to search for something.

1. Visibility - The user should always be informed of what is happening at any given time.
2. Language - Describe what is happening in a language that the user can understand.
3. Control and Freedom - Users do not like feeling restricted, so it should be easy to recover from mistakes and change plans. E.g. suggesting spelling correction but not enforcing it.
4. Consistency - Be sure to use consistent wording in the interface, e.g. using either "search" or "query", as the user will always assume there is a difference.
5. Error prevention - Help the user by making it hard to make mistakes and having to go back.

6. Support Recognition - The user should not have to remember what they have done or need to do.
7. Flexibility and Efficiency - Easy to use for first time users, but also efficient for expert users.
8. Aesthetics and Minimalism - Use free space to balance the amount of information shown.
9. Clear error messages - Error messages should be formulated in a way so the user understands the problem and can find out what to do next.
10. Help and documentation - Provide clear help if the user wants it.

Design for simplicity, structure, consistency and tolerance

Stone et al. (2005) suggests that one should design an interface with four main topics in mind; simplicity, structure, consistency and tolerance.

- One should keep the interface clearly formulated in the users' language and symbols and controls should feel intuitive to use and understand. Complex tasks should be divided into steps.
- The interface should be organised in a meaningful way, by e.g. placing connected functions close together, and placement should reflect the user's expectations.
- The appearance of the interface should be uniformly designed, including that the placement of icons should help making the interface easy to learn.
- Preventing use errors should be included in the design by e.g. reducing the number of mistakes that can be made and allow for easy recovery.

2.1.3 DESIGN FOR EXPERIENCE

The design theory in this section has been helpful in this project as it structured the approach to the design process and how to be aware and design for a pleasant user experience.

Attractiveness and functionality

It has been shown that people who feel happy become more creative and skilled at problem solving. This positive feeling could be the result of e.g. receiving a gift or watching a funny movie. An unattractive interface and an attractive one were used in tests to show that people found it easier to interact with the attractive version, independent of background and cultural belonging. Therefore, it is important to consider an interface's appearance when designing its functions as people will be more skilled at problem solving and open to new ideas if they have a positive feeling from looking at a beautiful interface. Norman concluded this theory with his statement: "Attractive things work better." (Norman, 2004)

Three aspects of product experience

Desmet and Hekkert (2007) define three components of a product experience: aesthetic pleasure, attribution of meaning and emotional response. These are the core components of any product experience and they determine how a product is perceived through the interaction.

The aesthetics experience is defined as "a product's capacity to delight one or more of our sensory modalities". The sensory experience is also influenced by the ability to detect structure or coherence in the product and detecting if it is a familiar or novel experience. The experience of meaning is created through the values and characteristics that the individual assigns to the product. This can be in the form of personality, metaphors or symbolic meaning. The meaning of a product is highly personal and is influenced by the individual's culture, background and associations. The emotional experience refers to the feelings and emotions that are elicited during the interaction or as a result of the experiences of aesthetic and meaning. Desmet and Hekkert state that it is "the interpretation of a product, rather than the product itself that causes the emotion". It is important to note that the emotional experience is a subconscious process.

2.2 METHODS

The methods used throughout this project are briefly described in this section. How they were applied in the project is described further in the research and development chapters of the report.

2.2.1 QUALITATIVE METHODS

Hierarchical Task Analysis

When constructing a Hierarchic Task Analysis (HTA), the task that is to be performed is divided into several sub-tasks considering the handling of the product or interface. The purpose of this method is to provide an overview of the system which can be used for further analysis (Jordan 1998; Bohgard et al. 2008).

Competitor analysis

The competitive products on the market are analysed with respect to their strengths and weaknesses to identify improvement opportunities or use previously verified success factors (Bergman and Klefsjö, 2010). This method is also referred to as benchmarking and is used as a basis for further development. In this project, this method was used to explore common interaction patterns and navigation of widespread applications with similar functionality.

Interviews

Interviews can be used to e.g. investigate how a system is used and define a user group concerning a certain topic. They are preferably performed at several stages in a project to ensure that the users' requirements are fulfilled and that the concept is suitable. An interview can be structured with a formal script to follow, semi-structured to allow for probing, or in the form of a discussion. The most common form are semi-structured interviews as it allows for asking further questions if the interviewee has much to say on the topic. (Bohgard et al., 2008)

Enhanced Cognitive Walkthrough

When conducting an Enhanced Cognitive Walkthrough (ECW), one can predict and identify potential usability problems in the human-machine system. The analysis is made on two levels of the HTA; the 0-level is called the functional level and is analysed by five questions. The 1-level is named the operational level and is analysed by four questions. The results from each level are compiled in a template where the issues of success/fail story, potential usability problem, problem seriousness and problem type are commented. (Bligård & Osvalder, 2010b)

The seriousness of the potential usability problem is graded on a 1-5 scale that represents the chance of successfully performing the task. The grading is shown in table 1.

<i>Grade</i>	<i>Grade in words</i>	<i>Explanation</i>
1	No	A very small chance of success.
2	No, uncertain	Small chance of success.
3	Do not know	Impossible to decide if success or not.
4	Yes, probably	Probably successful.
5	Yes	A very good chance of success.

Table 1. Problem seriousness grading for ECW.

The usability problems are also classified depending on the origin of the problem. The different categories used for classification are shown in table 2.

<i>Problem Type</i>	<i>Explanation</i>
User (U)	The problem is due to the operator's experience and knowledge.
Hidden (H)	The interface gives no indications that the function is available or how it should be used.
Text and icon (T)	Placement, appearance and content can easily be misinterpreted or not understood.
Sequence (S)	Functions and operations have to be performed in an unnatural sequence.
Feedback (F)	The interface gives unclear indications of what the operator is doing or has done.

Table 2. Usability problem origin definitions.

Predictive Use Error Analysis

A Predictive Use Error Analysis (PUEA) is used to predict and identify potential use errors, similar to an ECW. Questions are posed on both the functional and operational level of the HTA and a grading of the seriousness and classification of the error type and cause are done.

- Error types: The potential errors are classified into six categories; plan, action, checking, retrieval, communication and selection, where each category contains several different types.
- Error causes: The causes of the use errors are divided into five categories; lapse, slip, rule-based mistake, knowledge-based mistake and violation based on which level of decision making the user operates on.
- Consequence seriousness: The seriousness of the consequence of a potential error is graded on a 5-point scale where the explanations for each value are adjusted to the system. The value also depends on the severity of the secondary consequence that may arise.
- Error Detection: The 5-point scale shows how likely it is that the user detects the error before the secondary consequence occur. The scaling can be seen in table 3.

<i>Grade</i>	<i>Grade in words</i>	<i>Explanation</i>
1	Improbable	Extremely difficult to detect.
2	Remote	Difficult to detect.
3	Occasional	May be detected.
4	Reasonable	Likely to be detected.
5	Frequent	Most often or always detected.

Table 3. Definitions of grading of possibility of error detection.

Observations

In order to acquire an overall understanding of the use of the system and the attitudes towards it, observations can be performed as a complement to e.g. interviews. One then observes the everyday use of the system to see how different persons make use of it and how they react to it. The sentiments of the persons are shown through the physical handling and the occasional expressions of frustration or liking.

Use case

A use case describes a task that has a clear start and finish. It contains information about the circumstances of the situation to define what happens from start to finish in a detailed manner. Factors included in a use case are e.g. primary actor, goals, preconditions, exceptions, system information and post conditions. (Bligård, 2012)

Usability analysis

Usability is defined as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use” (ISO 9241-11, 1998). This can be evaluated by e.g. measuring the number of clicks needed to perform a task, or the amount of time it takes. The three factors effectiveness, efficiency and satisfaction are reflected in five aspects: Guessability, Learnability, Experienced user performance, System potential and Re-usability.

- Guessability is a measurement of how easy it is for a first time user to interact with the product by e.g. measuring how many mistakes are made and how long time it takes.
- Learnability evaluates how easy it is to learn how the product functions by e.g. observing if there are any patterns in the handling of the product and if some tasks are accomplished in similar ways.
- Experienced user performance considers if an experienced user can utilise the product in a highly efficient way by e.g. using short cuts.
- System potential measures how efficient the use of the product is by e.g. describing the number of steps required to accomplish a task. A high number of steps equals a low system potential.
- Re-usability is the ability for a previous user to use the product even after a long absence, and is measured by the effort required to remember how the product is used. (Jordan 1998)

2.2.2 QUANTITATIVE METHODS

Hesselgren

Hesselgren's 8 Basic Emotions Scale can be used to evaluate the emotions aroused when interacting with a system. The respondent is asked to scale his/her emotional response on a scale from 0 to 5 considering the emotions joy, liking, irritation, worry, depression, dislike, expectation and surprise. The respondent's understanding of the scale is aided through addition of words for each value on the scale. (Hesselgren, 1985)

Self-Assessment Manikin

The Self-Assessment Manikin (SAM) uses a 9-point scale to describe the respondent's state of mind concerning valence, activation and control. The scale is illustrated by a manikin to aid the understanding of the measurement. (Desmet, 2003)

Requirements specification

A requirements specification can contain both requirements and guidelines from the users and the company. The guidelines can also be weighed against each other to know which are most desirable to fulfil. The requirements should preferably be measurable so one can evaluate if they have been fulfilled. A requirement specification should be used in the concept evaluation chapter to ensure that the concept reaches the required goals. (Johannesson et al. 2004)

2.2.3 CREATIVE TOOLS

Expression board

An expression board consists of several images and is created to illustrate the expression one wants the product to emit. This visual aid is then used by the designer as inspiration by

expressing one or several words that the final product should be associated with. It can also be used as common ground when working as a group to come up with the product's visual aesthetics. (Österlin 2010)

Persona

A persona is a fictive user created to represent a specific type of user group and thereby identify the requirements posed by the group. The persona can contain information concerning age, physical characteristics, personality, profession, limitations, special interests and knowledge. The aim is to define the user group's requirements through the persona and can also be used for evaluating concepts. A persona should be created after collecting data concerning the users to ensure its validity. (Janhager, 2005)

Scenarios

To understand the requirements on the product, one or several scenarios can be formulated that describes a situation of the future use. The scenario can contain specifications concerning e.g. the environment, the person and his/her mental state. This specification is then used to describe and evaluate different functions and aesthetics of the product, as well as testing different theories. In order to acquire a broader idea of the usage, the product should be evaluated in several different scenarios. (Kaulio 1996)

Sketching

Sketching is used as a quick way to document ideas and communicate them to others in an understandable way. The initial ideas may be drawn on paper while the more finished ones are done digitally to facilitate changes and achieve a more finished look.

3 IMPLEMENTATION

This chapter describes the different activities of the project briefly and how the methods chosen have been implemented. An illustration of the process will also be presented. Included in the research phase is the formulation of a development guide for finding user requirements. Design guidelines for future smartphone applications are formulated from the final design of the concept.

3.1 PROJECT OVERVIEW

The two first activities are called System research and User study; these are performed to understand the system and its users. After that follows the Visual Elements Design chapter that investigates current Volvo Cars interfaces, the graphical profile for web interfaces, and how other smartphone interfaces have chosen to design functionality similar to that of the application. A goal formulation will then be formulated using the results from the three previous activities.

These four initial activities then contribute to creating the requirement specification and development guidelines. The requirement specification will be used to communicate with those that are to program the application when the project is finished. It is also meant to summarise the progress in an understandable way before moving on to concept design.

During the concept generation activity several concepts will be produced in text and images so that they will be possible to compare during the concept evaluation. Finally, one concept will be chosen and then completed to finished screen representations. An illustration of the project process is shown in figure 2.

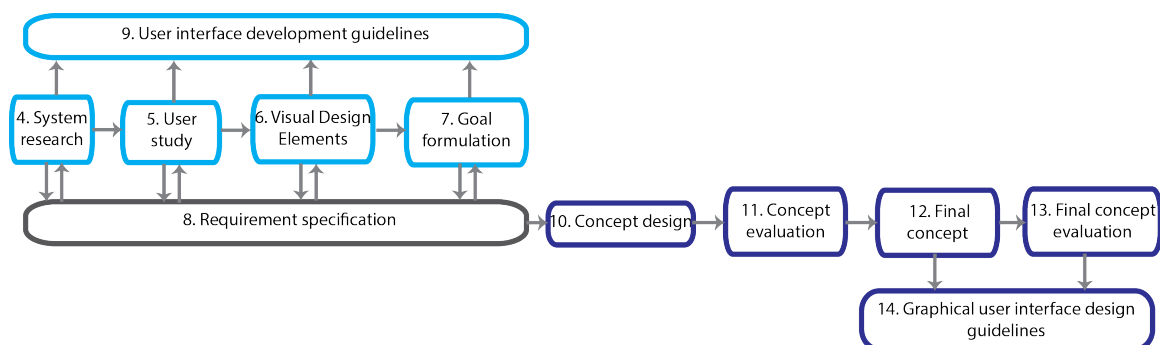


Figure 2. Illustration of the project disposition.

3.2 SYSTEM RESEARCH

The first activity after the start-up of this project is the investigation of the current systems and the preconditions for the application concept concerning e.g. software limitations.

The methods used here are chosen to help understand the systems and how the users interact

with it. HTAs of the most frequently used functions are constructed to acquire an overview and to serve as support for deeper analysis. ECW and PUEA are performed on the main steps to investigate possible usability flaws and user mishandling of the system. An efficiency evaluation will aid in future comparisons with the application concept to determine if it is in fact more efficient than the reference systems. The hardware of the smartphones currently used by the staff at Volvo Cars Torslanda are specified and the software described briefly. Finally, a usability analysis is used to determine the systems' guessability, learnability etc.

3.3 USER STUDY

The user study focuses on understanding the users of the current systems and future application concept. The primary method during this activity will be in depth interviews with Outlook and VROOM users. During the interviews, the users will be asked to perform a booking in the system and think aloud, they will thereafter fill in forms for Hesselgren and SAM evaluations. The interviews are chosen as the most important part in the research phase as Volvo Cars' brand statement "Designed Around You" is to be implemented throughout the project. A use case describing a typical booking of a meeting will be formulated to understand who interacts with the system and what the actors' roles are.

3.4 VISUAL DESIGN ELEMENTS

The next chapter of the research phase is the investigation concerning visual design elements. Volvo Cars' newly developed Brand digital guidelines will be studied to see what is applicable in app development for smartphones and what should be specified in the future formulation of the design guidelines.

There are several design guidelines available for iOS, Android and Windows app developers. These will be studied to define common features and elements that can be used in an application that is to be used in an html5 operating system that functions the same on all devices.

Furthermore, Volvo Cars' new website and mobile web will be considered to see what visual elements and interaction patterns can be implemented for the application. It is desired to create a common expression for all digital communication systems as the websites are designed very recently with the new Brand digital guidelines in mind.

3.5 GOAL FORMULATION

The goal formulation is meant to summarise the results from the previous chapters in an inspirational way to serve as support during the concept development phase. An expression board is constructed to illustrate the desired visual expression of the concept. Scenarios are formulated to describe how the functionality will aid the user in their daily work.

3.6 REQUIREMENT SPECIFICATION

The requirement specification will become quite extensive as it expresses demands generally as well as specifically for this booking application. Several divisions of the specification will be made, e.g. into functional, handling and design requirements. The explicit demands will also be used as examples in the development guidelines for extracting user requirements. The demands will be motivated and their origin specified in a matrix.

3.7 USER INTERFACE DEVELOPMENT GUIDELINES

A guide for extracting user requirements during the early stages of projects is desired by Volvo Cars (hereafter referred to as "development guidelines"). This guide should contain

examples of methods that are suitable during the research phase, how to implement them and examples of which kind of requirements can be extracted. The guide is meant to be used by business analysts and developers in future interface development projects to focus on the brand statement “Designed Around You”.

3.8 CONCEPT DESIGN

Several ideas for how the booking application will be constructed are made at this stage, beginning with the structural demands such as how to navigate to fit the user’s mental model. The visual aspects will be handled simultaneously to enable functionality and graphics to complement each other. The idea generation will first be done by hand to encourage creativity as details become less important. This activity is meant to produce a multitude of concepts so that there will be many ideas to choose from in the concept evaluation that follows.

3.9 CONCEPT EVALUATION

The evaluation will be based on interviews with persons from the user study reference group as well as inexperienced users that will represent the view of new employees at Volvo Cars Torslanda. The aim will be to compare the usability of the concept with that of the reference systems, so the methodology will be the same as in the user study. The interviews will be based on screen images of the concepts.

3.10 FINAL CONCEPT

At this stage of the project, all the screens of the final concept will be made to make it ready for programming. These will be made as illustrations with explanatory text that describes the interaction pattern.

3.11 FINAL CONCEPT EVALUATION

The final concept evaluation will evaluate the success of the application concept, thereby providing important feedback that can be used in the graphical user interface design guidelines as well as suggestions for future development and refinement. Naturally, the application will need constant updating as the facilities at Torslanda are currently being renovated and as the technology becomes more advanced.

3.12 GRAPHICAL USER INTERFACE DESIGN GUIDELINES

Screens from the final concept will be used as examples for how to apply the different design features in future applications so that the appearance of future applications will be coherent (hereafter referred to as “design guidelines”). The icons constructed for this application will serve as examples as a uniform design of all internal applications is desired. In addition, gestures and animations will be specified so that the interaction with future applications will be cohesive.

4 SYSTEM RESEARCH

The first activity of this project consists of an investigation of the current systems in order to understand the main functions and discover potential usability problems. The first step is to map the systems by constructing several HTAs, which are then used in further analyses using ECW and PUEA. The specification of the hardware available is stated in order to understand the conditions for the concept development. It is also important to consider the technical constraints that originate from the choice of html5 as the operating system used. Screenshots from both existing systems can be found in appendix 1 and 2.

4.1 HTA

HTAs are constructed of the two interfaces, VROOM and Microsoft Outlook. The tasks evaluated are chosen considering which needs the application is supposed to address and what level of functionality is expected. Therefore, the following tasks from the previous interfaces are evaluated below: book a room for a single meeting, book a projector, show schedules for resources, and show reservations. However, it should be noted that booking other resources than rooms is only available in the VROOM interface, but the function should be considered for the development of the application later in the project.

4.1.1 RESULTS

The HTAs in figures 3 and 4 describe the most important task, i.e. booking a room for a meeting (and inviting others through the scheduling assistant for the Outlook version). This task was chosen as the focus of this study according to the project definition and consultation with the supervisor.

It was discovered that the systems are very different in their construction concerning navigation; VROOM has a horizontal navigation that directs the user from one screen to another, thereby showing a clear path of action. This is beneficial as the user is given clues concerning what to do next, but it can be irritating if the user wants to change a setting that was determined in a previous screen. Outlook is completely different as it allows the user to perform most tasks in any preferred order, but it does not provide a clear path to completing the task. This is considered a more hierarchical navigation structure as it reveals many different functions and menus as the operator navigates through it and there are plenty of possibilities to change settings at any given time. This much freedom and an interface with many more functions besides booking resources can become difficult for a first-time user, but is desirable for an experienced user as it provides several alternatives and integrated functionality.

As can be seen from the figures, VROOM has a very clear path of interaction and directs the user to the next task when the previous has been completed, making it inconvenient to go back even though it is possible. This can be appreciated or disliked depending on the level of freedom the user desires, but it is time consuming to go through all the steps and loading new screens for every time a room needs to be booked. The Outlook system works very differently as the user has great freedom to choose his/her own path to booking a meeting

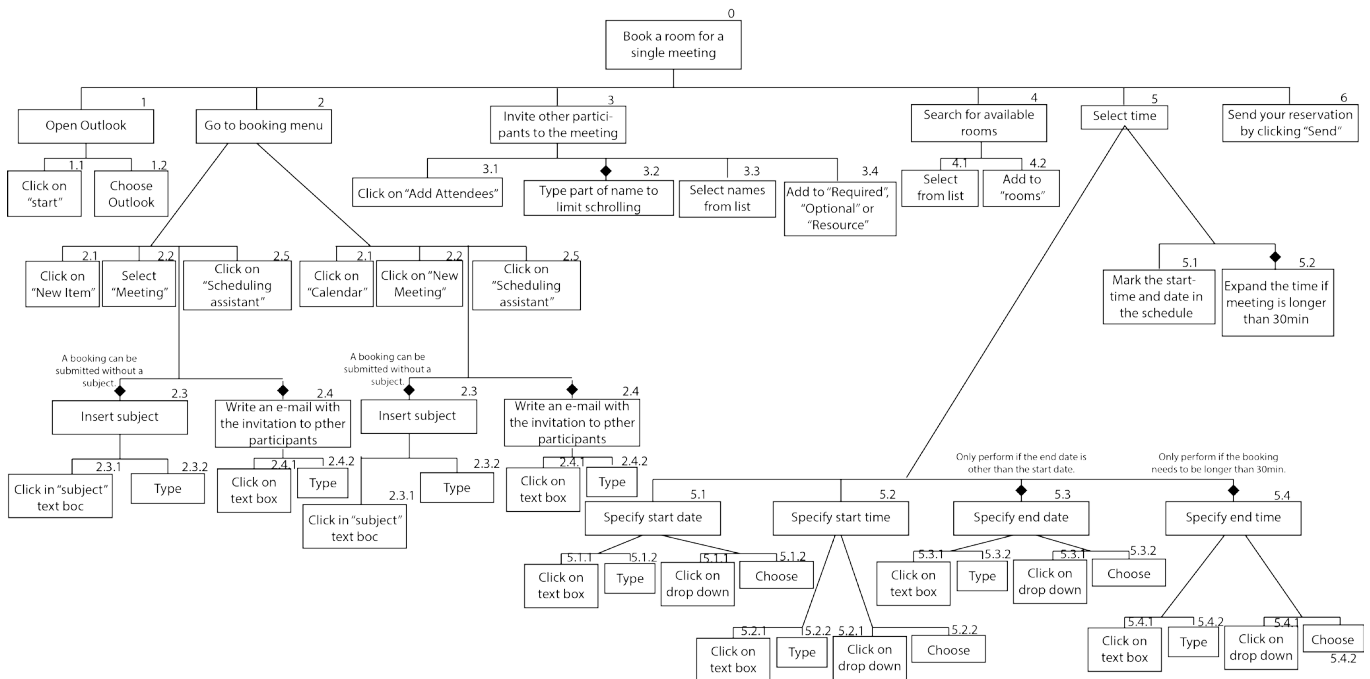


Figure 3. HTA describing the task of booking a meeting in Microsoft Outlook.

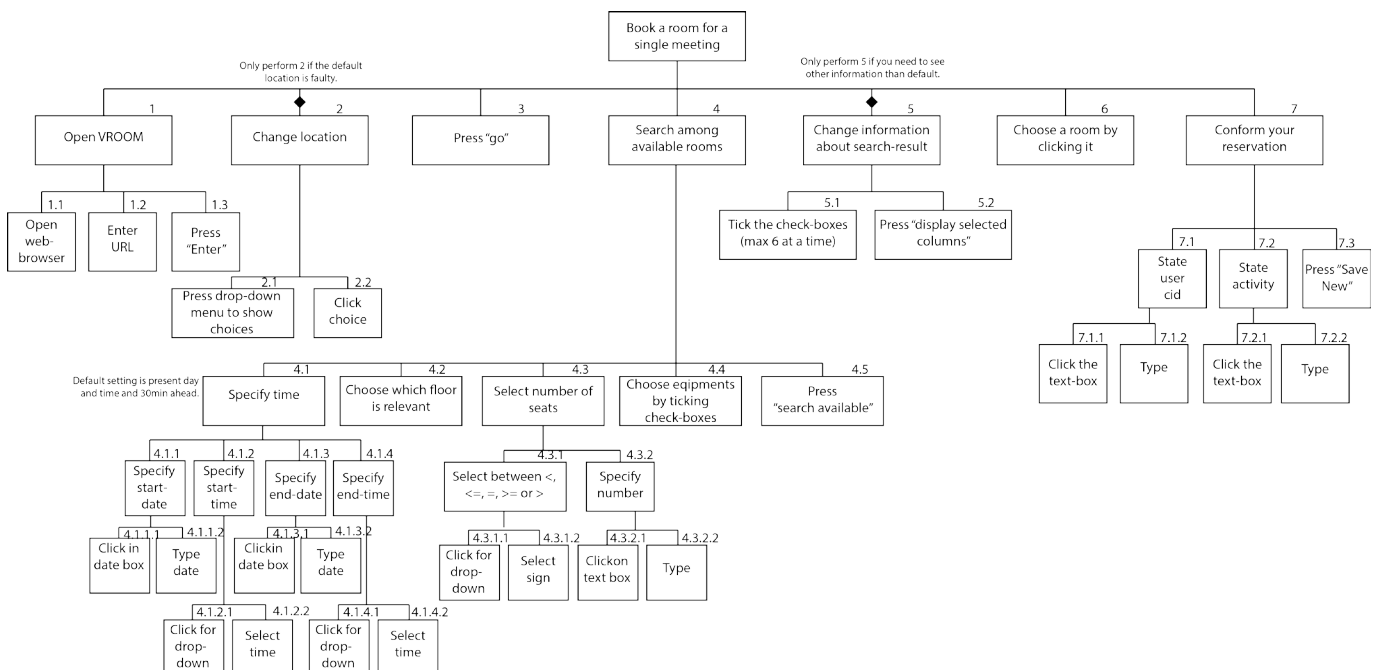


Figure 4. HTA describing the task of booking a room in VROOM.

and there are various tools available if help is needed. The same function can be found in multiple places but all lead to the same end result.

The HTAs were used for further evaluations and the complete set constructed can be found in appendix 3 and 4.

4.1.2 IMPLICATIONS

When investigating how to interact with the Outlook booking system, it was discovered that it allows the user to do the steps required in many different orders. This made it hard to construct the HTAs as the different paths should be illustrated as having equal importance. Instead, the HTAs show the most common sequence of action according to the staff.

Outlook has two paths one can take when booking an appointment; these were evaluated separately as they can work separately. They can be combined, but the HTA constructed for that type of interaction became too complicated and showed no clear result concerning interaction path or efficiency.

4.2 EFFICIENCY EVALUATION

The efficiency evaluation is mainly based on the number of clicks demanded to complete a task in the different systems. It was also taken into consideration how often the user has to use the keyboard.

4.2.1 RESULTS

The number of clicks is counted in three ways; maximum amount, minimum amount and most probable amount in order to give each system a fair count. The maximum amount is based on the scenario where the user has to change all default choices in the system, e.g. location and time settings. The minimum count assumes that all default settings are correct and the user can therefore skip several steps in the HTA. The most probable count assumes that the general default settings, such as location and date, are correct, but that the user is planning to book the resource some time later that same day. The results can be seen in table 4.

Number of clicks (Max/Min/Prob)	Book a room	Show my reservations	Show a specific room's schedule	Book a projector
Microsoft Outlook	20/10/15 (1) 23/12/15 (2)	4/3/3	8/8/8	NA
VROOM	53/9/35	4/4/4	12/6/6	38/12/19

Table 4. Number of clicks required to perform the tasks represented by the HTAs.

There are two ways to book a meeting using Microsoft Outlook.. The first one (1) works similarly to VROOM as the system searches for available rooms according to the time and location the user has specified, and one can then choose a room from the displayed list. The second alternative (2) is to use the "scheduling assistant" in which the user chooses to display one or several rooms' schedules next to all those invited in order to find an available time. It should also be noted that the numbers for Outlook include the steps of inviting others to the meeting and sending that invitation, and when viewing one's reservations, one can also see those one is invited to by others. These functions are not available in VROOM. The number of clicks for Outlook is counted based on inviting three other participants to the meeting.

The evaluation of how many times the user has to change to use the keyboard instead of

the mouse is done as it is often perceived as irritating and impractical. This is especially true for handheld devices as the keyboard takes up much space on the screen and one most often has to use both hands to reach all the letters (Karlson et al., 2008). Therefore, it is important to consider the need for typing information into an application. The results from the evaluation are seen in table 5.

Uses of keyboard (Max/Min/Prob)	Book a room	Show my reservations	Show a specific room's schedule	Book a projector
Microsoft Outlook	6/0/2 (1) 6/0/3 (2)	0/0/0	0/0/0	NA
VROOM	6/2/4	0/0/0	1/0/1	6/3/5

Table 5. Number of uses of keyboard required to perform the tasks represented by the HTAs.

As it was not possible to find a user that is equally adjusted to VROOM and Outlook, estimations had to be made concerning the time necessary to perform the functions. The result of this estimation was that VROOM is more time consuming for booking rooms as the user has to go through several screens before the appointment can be confirmed, while Outlook only utilises two or three screens. Therefore, the compiled loading time for VROOM was larger than for Outlook, which has a great impact on the efficiency of the systems.

4.3 ECW/PUEA

ECWs and PUEAs were conducted based on the results from the HTAs in order to detect potential usability problems and define the consequences of these. The methods were used for the functional level of all HTAs. The method for the operational levels was used on all 1-levels, but only for the 2-levels that seemed relevant concerning the level of complexity of the task.

The construction of the ECWs and PUEAs shows that most problems occur due to a lack of knowledge of the system. These problems could be relevant for this project concerning minimising the time it takes for new employees to learn the system, but nearly all users are frequent or expert users that work with the system on a daily basis. However, a few slips-and lapse-mistakes could be detected that would cause possible irritation for the user. All tables constructed were examined to evaluate the systems' usability problems and the ones for the functional level can be found in appendix 5 and 6.

4.3.1 VROOM

As VROOM has a very clear path for the user to follow, the problems here consists of the lack of clues provided by the system. If e.g. the user commits a slip by selecting the wrong item from a drop-down, it can be hard to detect that mistake once "Go" has been pushed as the choices made are rarely shown during the rest of the process.

A potential usability problem is also that the user can choose to change the time of the reservation in the last step of the booking without confirmation that the room is available. This can lead to frustration as the user would have to go back in order to change the time and find another suitable room.

The amount of feedback is also considered lacking in VROOM. Even though several buildings have changed to use Outlook, they are still available as choices in the system, which can be confusing as they contain no available resources for booking. This could be hard to detect for the user. Moreover, the system is not adapted to the user's mental model. E.g. the user should not choose more than one possible floor for their booking as VROOM applies Boolean

logic in such a way that the room has to be present on both floors to fulfil that requirement. This means that if the user thinks that “I want a room on either the 2nd or the 3rd floor” and marks both boxes, the search will not generate any results.

4.3.2 OUTLOOK

The Outlook system works very differently from VROOM, especially considering that booking is just one of the functions it can perform. Therefore, one of the most common potential problems discovered is connected to the ability to find what is needed among the various icons and functions. The possibilities for recovering from use errors are greater in this system as fewer screens and better overview is applied.

As previously stated, there are numerous paths the user can take to perform a task. However, this could also be a problem as the user could be confused by not being sure what the next step is. It is also possible to miss a step, e.g. inserting a subject for the meeting, but the system provides an opportunity for recovery through pop-ups that disrupt the process.

4.4 USABILITY ANALYSIS

Based on the construction of HTAs, ECWs and PUEAs, the systems’ respective usability is evaluated concerning guessability, learnability, experienced user performance, system potential and re-usability. The analysis is based on the author’s experience of the system as well as comments and observations of the staff.

4.4.1 VROOM

The usability evaluation of VROOM is mostly based on the author’s own experience as the usage of it is limited to a certain area and most of the staff has transitioned to Outlook. However, opinions expressed at the start-up of the project have been taken into consideration.

- **Guessability:** The guessability of the system is considered quite high as clues are readily available and the number of paths that the user can take is limited to two (backwards or forwards). When testing the system for the first time, the time required was relatively short. However, the feedback in the system concerning e.g. why no rooms were found if you e.g. chose several floors lowers the level of guessability (8/10).
- **Learnability:** Due to the limited amount of paths and options, the learnability of the system is high and the user does not need many tries before understanding the system and can use it efficiently (9/10).
- **Experienced user performance:** An experienced user is unfortunately limited by the system as there are few opportunities to take short-cuts. The user has to go through all steps irrespective of experience level. This could become irritating for the experienced user as the process can become time-consuming (3/10).
- **System potential:** The number of different screens the user has to navigate through to book a resource is considered extensive. However, the user is not required to fill in anything in one of them (the filtering options) (6/10).
- **Re-usability:** If a user were to use the system after a long break, it is considered easy to remember how the system is used as the system is not very complicated and has a limited number of functions to remember (9/10).

4.4.2 OUTLOOK

Outlook contains many more functions than just booking rooms, it is foremost an e-mailing and calendar system.

- **Guessability:** It can be quite difficult for a first time user to find the desired functions as there are numerous amounts of paths and choices in the interface. The user can come to

the booking menu from two different screens (as seen in the HTA), but can also choose to book the meeting in two different ways. However, the icons and text indicating the function is highly informative and placed next to the e-mailing function making them relatively easy to detect and interpret (6/10).

- Learnability: When having used the interface a few times, it becomes easier to know what to do and sort out information that is not required to fulfil the task. The level of learnability increases as the icons indicating the functions are quite large and simple in design. They are also aided by explanatory text (7/10).
- Experienced user performance: If the user interacts with the system on a daily basis, he/she should become very efficient at using it as there are shortcuts and simplified paths. The user is not forced to go through steps that are not required as all functionality is meant to be available in just two screens. The user can e.g. choose to invite people present in an e-mail conversation directly from the message (9/10).
- System potential: As stated above, it is possible to reduce the number of steps taken in many ways as the system is constructed to work together with e-mail and calendar functionality. However, the user can also choose to take a path that could result in more steps (8/10).
- Re-usability: Outlook has numerous functionality besides booking rooms, which could make it somewhat difficult to remember how to book a room if the user has been absent from the system for a longer time. Due to the fact that the icons are highly graphical and aided by text to further explain the function, the re-usability should still be high if the user has used the system frequently before (7/10).

4.5 SOFTWARE INVESTIGATION

As stated in the introduction, the concept is to be adapted to html5 as the purpose is that the same code should be used on many different platforms. It also means that one can design a single graphical interface to be used on all devices, and when a new smartphone is introduced at the company, the application will already be ready for use independent of the model. However, as the physical properties of the devices are different, one should not design the interface so that interactions are made through the hardware of the phone. (Cajic, 2013-02-13, www.caniuse.com, 2013). Using html5 instead of native coding can also result in the user not recognising the interface and how to interact with it. The different devices today each apply their different navigation structures which poses a challenge for creating a universal application that should be easily understood for all users. Things like font and icon design also varies. (Karlsson, 2013-03-07)

The limitations posed by this choice of coding are primarily that it will be difficult to implement concepts that include the use of the hardware of the phones, and that 3D objects should be avoided. One should e.g. design vital functions to be independent of the use of cameras or physical buttons. Concerning 3D objects, large interactive animations such as e.g. building models, should not be used as they might result in a need for hybrid coding or slowing down the application. (Widar, 2013-02-17)

Some of the main benefits with native programming compared to html5 are that native applications can be used offline, are able to safely store information on the device and support background processing. They also allow for the specific native look and feel that results in the experience the users expect. However, it is possible to create a code in a html5 application that makes the interface change appearance depending on which operating system it is opened on, e.g. concerning choice of font (www.forbes.com). The benefits of choosing html5 is e.g. that the user is not required to download the application, it is faster and cheaper to develop than native applications and upgrades can be efficiently distributed (www.guardian.co.uk).

Html5 is not yet considered mature enough to replace native applications, but the development is constantly improving so the differences in which elements one can use in comparison with native programming are diminished (wiki.developerforce.com, 2013). This has been experienced by the author as the limitations of html5 decreased during the course of the project.

4.6 INTERACTION ANALYSIS

This section generally describes the different ways in which a user interacts with smartphones depending on if they utilise iOS, Android or Windows. As the concept is to be created for html5 and will thereby look the same for all devices, it is important to consider e.g. which gestures are used during the interaction and where functionality like backward navigation is placed.

4.6.1 iOS

Some of the staff currently uses iPhone 4. Application icons take up the majority of the screen space and are uniformly designed as rounded squares with text underneath to help identify the name and increase learnability. The navigation is mainly hierarchical and most applications have a backward-button at the top left corner of the screen. Otherwise, the large hardware button is clicked to get back to the phone's start screen. The transitions between different screens and applications are simple but smooth in their design in order to create a flow in the interaction. When tapping an application on the main screen, the icons move towards the edges of the screen to make room for the application window which grows from the middle of the screen – this will illustrate the user's mental model that the application is "opened up"; when the application is closed, it shrinks back into the middle again (Apple Design guidelines, 2013). The transitions inside an application are often made so that the next page slides in from the side or is opened up from the middle to illustrate the navigation pattern.

4.6.2 ANDROID

The staff that does not want an iPhone is given a Samsung Galaxy SII which uses the Android operating system. The icons are not as standardised as for iPhone, however, they are the same size. Text is also used as a complement to the icon to facilitate for first time users. The Android system applies a hierarchical navigation structure, but the use of hardware buttons is more common as the user has access to several. When opening an application, the screen becomes instantly blank before the application is opened. The same way of changing between screens is used within most applications, except where the user is encouraged to flick to the side to show e.g. images in a carousel.

4.6.3 WINDOWS

Smartphones from Windows are not yet that widespread in use at Volvo Torslanda, but some early adopters have chosen a Nokia Lumia. They are therefore considered in this project. The Windows interface is mainly text-based with a focus on font instead of icons. The navigation also differs from Android and iOS as the hierarchical navigation is combined with panoramic, i.e. the window shown is part of a much larger screen and the user flicks the screen horizontally to see another part. The flickering is also combined with the use of e.g. a hardware backward-button. When the user chooses to open an application, the icon lingers while the others fade away and the interface spins around to indicate that an application is being opened. The animation when switching page is different depending on which level you are in the application and how great the change is.

4.6.4 COMPARISON

One of the few common elements for the systems is that they all show a grid of applications

as the start page, but they look different as Android and iOS use icons while Windows uses coloured fields or photos. Inside different applications where the user is required to choose a time, all OSs use pickers, probably as it is considered the most efficient alternative. The user is also able to switch between screens by flicking to the side from the main screen. Android and Windows widgets can display information on the main screen that is retrieved from the application; e.g. the user can see samples from the gallery application directly on the main screen without having to open the application. This type of widget is not yet possible to apply in html5.

As the interaction with the different systems is partly very different, the issue for this project becomes how to create the best user experience for as many users as possible independent of their previous OS. One does not want any user to feel alienated by the system. Therefore, it is considered reasonable that some specific features from the different systems can be used, but the interaction and functionality should be simple so that the user will not be confused by a new interaction flow as well as new functionality.

4.7 HARDWARE SPECIFICATIONS

The smartphones used by the staff today are either a Samsung Galaxy SII or an iPhone 4. The Windows phone has not spread quite yet, but it is recommended for consideration in this project. The relevant hardware specifications of these are presented in table 6 to specify the devices on which the application is supposed to function.

	Samsung Galaxy SII	iPhone 4	Nokia Lumia
Screen size	4,3"	3,5"	4,3"
Resolution	800x480px	960x640px	1280x720px
Camera	8MP (back), 2MP (front)	5MP (back)	8MP (back), 2,1MP (front)
OS	Android Platform 2,6	iOS 6	Windows Phone 8
Pixel density	218ppi	330ppi	342ppi
GPS	A-GPS	A-GPS	GPS

Table 6. Summation of the hardware specifications for the smartphones currently used by the staff.

4.8 SUMMARY

VROOM has a clear path of interaction but Outlook is more versatile in its usage. It is important to provide clues concerning what to do next and what has been performed, but both interfaces lack in this respect. One must also show previously made choices and give feedback that an action has been done so that the user understands the system and feels in control. Outlook has the clear advantage that it is connected to the user's calendar and it is possible to invite others to a meeting, but it does not allow the user to sort through a large amount of rooms based on filters as VROOM does. VROOM is very user friendly for a first time user, but Outlook has more functionality which makes it more desirable for experienced users.

Html5 is under constant development and the differences to native code are becoming smaller. Gestures are now possible as well as most animations. The only drawback is that native code is still faster and easier to adapt to each device as it contributes to a "native feel" of the application.

The main difference in navigation between the devices is the access of hardware buttons and how the animations between screens have been done. The Windows phone has not

specified its attributes as well as iOS and Android as it has not been on the market that long. However, the similarities between the devices indicate that there is a possibility to design applications that do not alienate users despite their previous experiences.

5 USER STUDY

This chapter of the report describes the investigation of the users of the systems. The first step of the evaluation is the gathering of people for a reference group and formulation of an interview guide. The results are then compiled to summarise the users' opinions of the current system, but also to define how they would like the concept to aid them in their daily work.

5.1 INTERVIEWS

The reference group for the interviews was chosen considering their respective stakeholder role in the project as well as their general interest in the subject. It consists of 5 men with differing work assignments at Volvo Cars and ranging in age from 25 to 57. The interviews are semi-structured in order to allow for probing and the complete set of questions can be found in appendix 7. According to Volvo Cars' brand strategy "Designed Around You", the questions were organised to first ask the users how they would like to work and finishing with how they work now. This was done in order for them to be more creative and open to new ideas when describing their desired work day. The interviews revealed desires of new functionality for the concept, as well as complemented and confirmed the problems with the current interfaces.

5.1.1 VROOM

The greatest drawback with the current system VROOM is considered to be the need for log in and password despite using a personal device. The visual design of the interface is also considered dated and needs adapting to other Volvo Car Corporation interfaces. The frustration with having to cancel one's reservation in VROOM as well as in the regular calendar was also frequently expressed. It is common that rooms are booked in the schedule but are actually free as the booker has forgotten to cancel. Therefore, the system is seen as hindering optimal usage of the rooms.

Moreover, it was discovered that booking of separate equipment like phones or projectors is seldom used as most rooms have been or are being equipped. It was also stated that users prefer using their smartphones or computers for e.g. conference calls as it is too time consuming to book and fetch the equipment from the reception.

5.1.2 OUTLOOK

The reactions towards Outlook were generally more positive than to VROOM, mostly because of the integrated functionality between the calendar, booking system and e-mail. The most positive effect of this is that if you delete your appointment in the calendar, it is also cancelled in all other participants as well as the room's booking schedule, making it available to others. However, it was also stated that the system can be overly complicated due to the multiple functionality that is readily available but very seldom used. The visual appearance of Outlook is seen as professional but quite cluttered, which can make it hard to find what you are looking for. Even so, it is considered more modern and efficient than

VROOM.

5.1.3 SUGGESTIONS FOR CONCEPT

One of the most prominent desires for new functionality is the ability to find directions to a room, most preferably in a graphical manner e.g. via a map or GPS. It is a common problem that people cannot find the room they have booked or been called to, resulting in that one can find people walking the halls and asking for directions.

Another feature is the possibility to see an image of the room through the application, as it is important for the booker to get a feel for its interior; the functionality would be beneficial as e.g. colours and furniture type can greatly affect the mind-set of the participants of the meeting. This is particularly important to consider when costumers are invited to the building and one wants to impress them or make them feel respected.

A desire for quick and efficient usage of the application was also expressed, especially considering finding available rooms. It was also stated that the interviewees would like to choose all requirements in one page. The system should also be able to suggest alternatives even though they do not exactly fit the requirements, as it is often possible to move a meeting by a few hours or compromise with the desired equipment.

5.2 HESSELGREN

The Hesselgren method was used to evaluate the users' emotions towards the systems. The interviewees were asked to perform a booking in one system at a time and then fill in the form to ensure that the experience of the system was fresh in mind. The graph in figure 5 shows a comparison between VROOM and Outlook based on the average result of the interviews.

The graph shows that the emotions evoked by both systems are quite weak. This can be explained by that the systems are supposed to be used on a daily basis and work without the user having to think about it constantly. However, the negative emotions are slightly stronger towards VROOM which is consistent with the opinions expressed during the interviews. The high value for VROOM concerning surprise was explained by the interviewees being surprised that this kind of system could still be in use, which gives it a negative meaning.

5.3 SAM

SAM was used to evaluate how the interface made the user feel during the usage, especially considering focus and control. Similar to the Hesselgren evaluation, the interviewee was asked to fill in the form directly after the usage so that the results would be based on the use and not the memories of it. A comparison of the average result is shown by the graph in figure 6.

As for the Hesselgren results, the users are slightly more positive towards the Outlook system, but otherwise, the results are similar. Some interviewees expressed that the multi-functional interface of Outlook could be somewhat confusing, while VROOM has a clear path of action and provides clues to the next step. This explains the fact that VROOM got somewhat higher scores for control and activation. It might also matter that all users have experienced VROOM before Outlook was introduced and are therefore more accustomed to it.

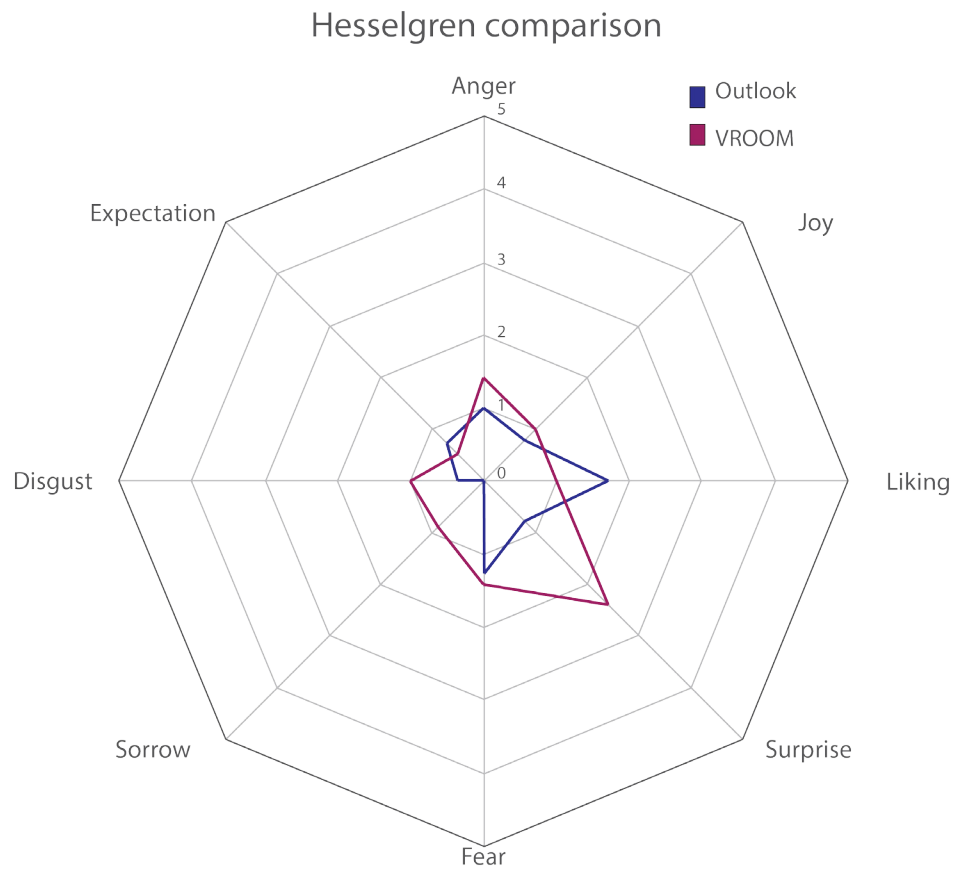


Figure 5. Graph illustrating the difference in emotional response for Microsoft Outlook and VROOM.

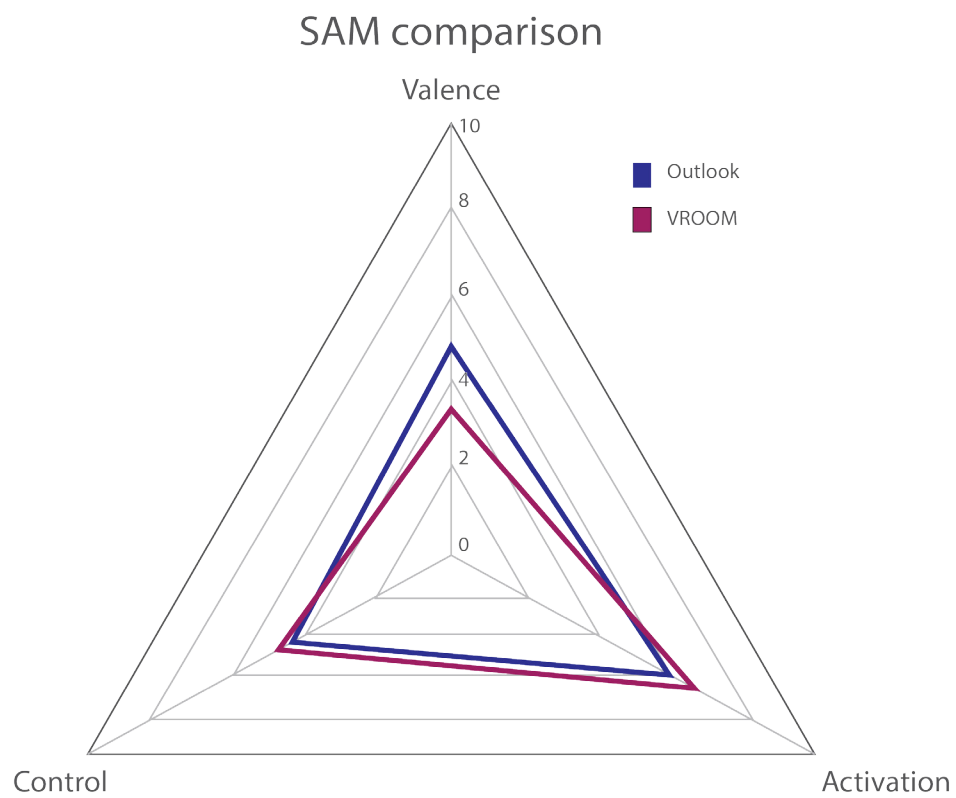


Figure 6. Graph illustrating the differences between Microsoft Outlook and VROOM using SAM.

5.4 USE CASE

A use case describing the current use of the system was constructed to understand the users' interaction with the system and the actors involved. It would also aid in the formulation of the users' requirements on the new system and what the overall goals are. The use case is based on the information received during the interviews. Volvo Cars' template for constructing use cases was used and the summation of the results is presented in this section. An illustration of the use case is seen in figure 7.

5.4.1 ACTORS

The number of actors in this use case can be divided into three: the booker of the meeting, the other participants and the system in which the booking is made. The final actor can alternatively be divided into several different systems that administer the booking and schedule respectively. The booker, named Project manager in this use case, is a primary actor as he/she initiates the flow. The other participants, named Colleagues, can be both the staff at the company and invited guests. These are also primary actors in the sense that they initiate the confirmation of the meeting without which the use case cannot be completed with the desired outcome. Colleagues invited to the meeting can be stated as "required" or not by the Project Manager. If the meeting is to take place, all "required" participants must be able to attend. The system is considered a secondary actor as it only aids in the completion of the flow but never initiates an activity.

5.4.2 PRE-CONDITIONS

- All actors make use of the same system to keep track of their calendars and e-mail. This is required so that they can view each-other's as well as the rooms' schedules.
- There are rooms available for booking in the system.
- There is at least one time available for the participants to meet that coincides with there being an appropriate available room.

5.4.3 POST-CONDITIONS

- The meeting is booked in the system and all participants have accepted the invitation.
- The room is indicated as occupied by the Project manager during the time booked.
- The time of the meeting is added to the participants' calendars including information of place, time, and participants.
- The meeting cannot occur if there are no available times that fit both the required participants' and the rooms' schedules.

5.4.4 EXCEPTIONS

The exceptions describe the alternative flows that can occur. In an ideal case, no exceptions occur.

- At step 5 in the booking of a meeting, if one or more of the required participants cannot attend, a new time has to be suggested that better suits the attendees. The project manager suggests a new time to meet based on the participants' schedules and the availability of rooms. The use case resumes in step 6 or the use case ends if there are no available times.
- At step 5, if there are no available rooms suitable for the meeting, a new time has to be suggested by the project manager. The use case resumes in step 6 or the use case ends if no rooms can be found that suits the participants' schedules.
- One or more of the required participants have chosen not to accept the invitation to the meeting despite being free according to the calendar. The project manager then has to re-do the booking process. The use case resumes in step 3 or ends if there are no other available times.
- If one or more of the required participants have to decline, the meeting has to be

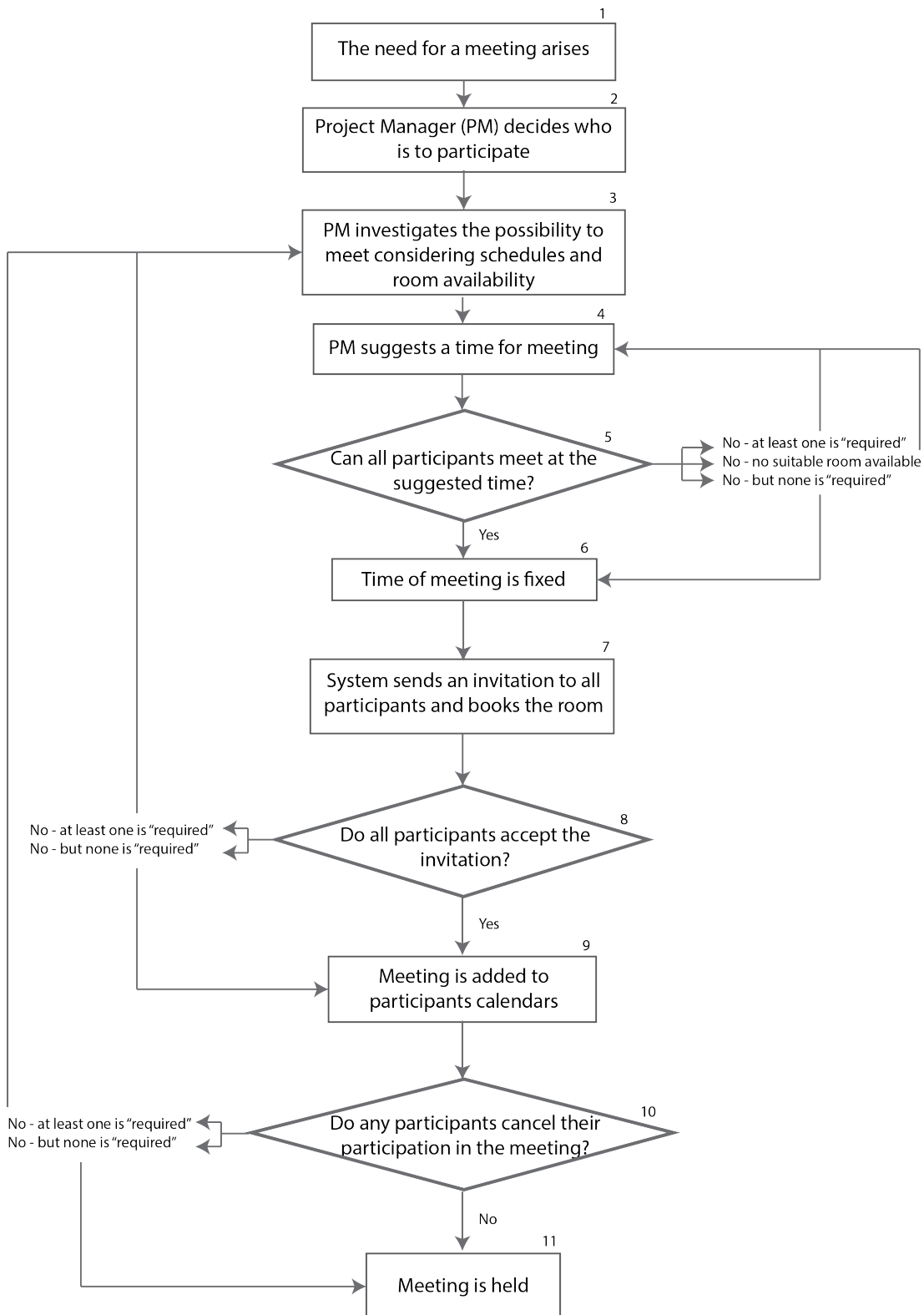


Figure 7. Illustration of use case results demonstrating the process of booking a meeting.

rescheduled by the project manager. The use case resumes in step 3 or ends if there are no other available times.

5.5 SUMMARY

During the user study, it became apparent that most consider VROOM to be dated and unnecessarily complicated considering the amount of steps required to perform a task. However, its benefits include being easily understood and sufficient enough to still be used.

Considering the number of meetings the interviewees stated that they participate in each week, it is important to make sure the concept is quick to use and allows interruptions in the interaction. All interviewees interact with either VROOM or Outlook on a daily basis so efficiency is extremely important. The results from Hesselgren and SAM showed that the emotional response towards the systems is quite low, probably because the users have become accustomed to them, however, certain interviews revealed high frustration.

The use case shows that a flexible booking system is highly desirable as changes can occur due to participants declining invitations. Meetings might have to be rescheduled and users often find the rescheduling of meetings irritating as they have to start over. The use case also point out the importance of all users and rooms being present in the same system.

6 VISUAL DESIGN ELEMENTS

This chapter of the report describes the different graphical guidelines that are taken into consideration for the concept design. The Brand digital guidelines are meant to be used for larger screens such as tablets and computers and are still under development. Volvo Cars currently supplies their car owners with an application called Volvo On Call, which can help them to manage certain functions of the car from a distance. The new website and mobile website were launched in February and are expected to function as examples of how to apply the Brand digital guidelines. Finally, certain specific design guidelines from literature and real life are presented as they are considered relevant for this particular type of application.

6.1 BRAND DIGITAL GUIDELINES

The Brand digital guidelines provided at the start-up of the project are adapted to web interfaces for computers and hence, adjustments should be made when applying them to the limited screen of a smartphone. Furthermore, the document is not completely finished as e.g. the colour specification has yet to be formulated. Some of the most prominent features considered are stated in this section.

The design voice of Volvo Cars' digital interfaces is supposed to express Clean, Confident and Simple. Negative space should be used to let the content breathe and objects shown in the same screen should not compete for the user's attention. One should not use "loud" objects or information packed screens as Volvo Cars is a confident brand that does not need to assert itself. For the same reason, icons and buttons should be kept flat for a simple expression. Images or products should take up the majority of the screen and text should be short and concise.

The Volvo iron mark should be present in the top left corner for desktop websites, but the positioning is not defined for mobile applications. It is important to keep a certain amount of space free around it and that the background is fairly one coloured. The colours around it should be complementary to the brand.

The fonts used for web interfaces are Helvetica and Arial, but it is important to note that the mobile web uses different font depending on which OS it is used on. The specific Volvo Sans font should not be used for the body. Buttons in web interfaces should be square with a white or grey fill to complement the clean and simple expression. It is stated that all of Volvo Cars' digital communications should have a hierarchical navigation structure as it is familiar to most users and is easy to implement.

6.2 VOLVO ON CALL APPLICATION

This application is meant for the customers who buy a Volvo of a recent model that is connected to the internet. It allows them to control certain functions of their car from their smartphone. The user can e.g. lock and unlock the car from a distance, see the location of the car on a map, turn on the heat or study previous travel routes. The application was designed to appear luxurious and attractive, but there are no clear guidelines for smaller

screens like smartphones and it is not considered appropriate in comparison with Volvo Cars' newly launched website.

It is important to note that the Volvo On Call application is programmed in native code, meaning that the interface looks very different depending on which device one uses. The way to navigate is also somewhat different but always includes swiping sideways, which is inspired by the Windows phone (Karlsson, 2013-03-07).

When starting the application, the user is shown the screen in figure 8. The screen makes extensive use of negative space and has a clean and minimalistic expression. The iron mark and application name are the most prominent features on the page as they take up half the screen. The background is mainly one coloured but there is a discrete image that creates movement in an otherwise strict screen.

Figure 9 shows the page for route information. The colours used are muted and discrete with use of accent colours to separate information. Symbols or text is used depending on the amount of space available. The symbols are simple in their expression to be easily interpreted. For this particular screenshot, the symbols on the bottom are further explained by the colour coded number above.

One can also see that the interface is quite square in its appearance by using straight lines and little use of rounded corners. This is also in line with the graphical profile for computer interfaces and is assumed to be inspired by certain design features of Volvo Cars. Animations, effects and fading are modestly used and the user is seldom required to use the keyboard to type information.

6.3 VOLVO MOBILE WEBSITE

Volvo launched a new website in the beginning of 2013 which has been designed with the new Brand digital guidelines in mind. The appearance is also meant to serve as inspiration for the next upgrade of Volvo On Call (Karlsson, 2013-03-07).

As can be seen in figures 10 and 11, the interface is very bright with much negative space and a focus on images of the cars. The functionality is appropriately limited as the user is offered the choice of looking at images of the cars or book a test drive. More functionality is however hidden in a drop-down at the top of the screen. Scrolling is only used vertically. A list-menu can also be revealed for more options.

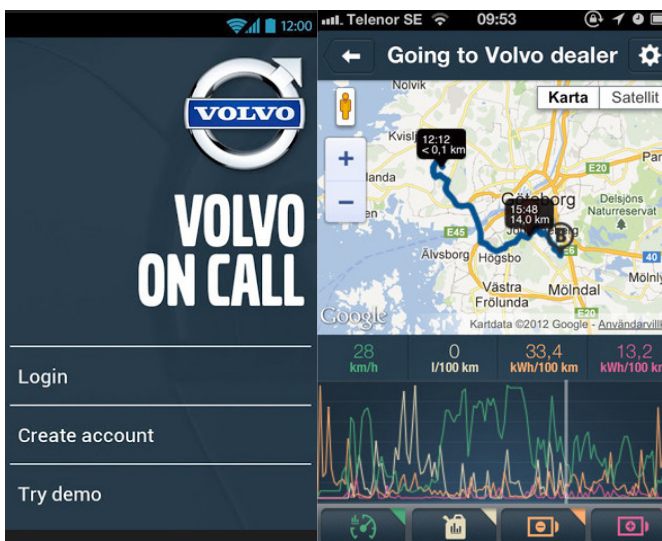


Figure 8. Volvo On Call start screen.

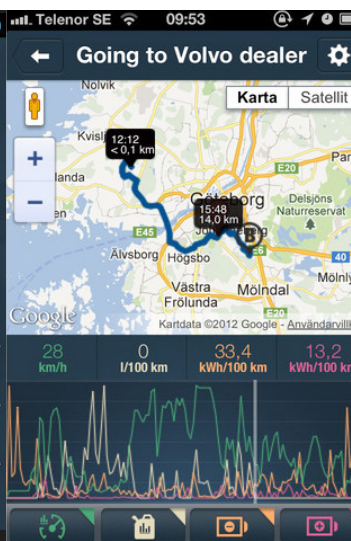


Figure 9. Volvo On Call route information screen.

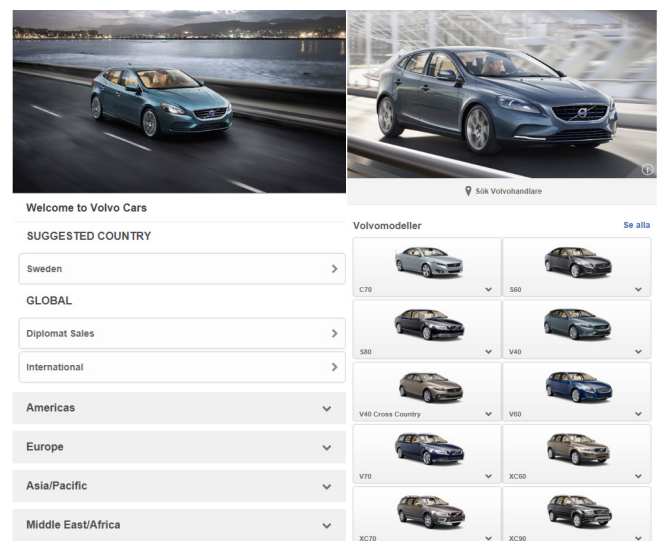


Figure 10. Volvo Cars' mobile website start screen.

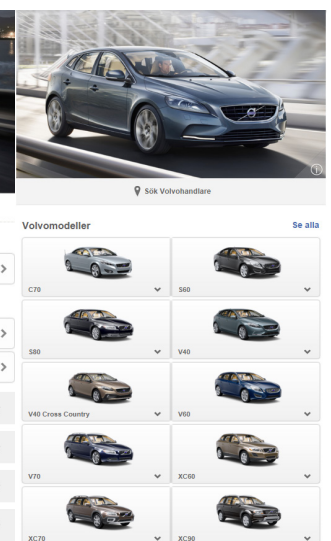


Figure 11. Volvo Cars' mobile website.

The colours of the interface are discrete white and grey in order to let the images of the cars attract the most attention. The background can be described as off-white with thin diagonal stripes that are used to create a depth in the background. Text is most often used in single sentences to avoid cluttering and maintain the clean expression.

6.4 COMPETITOR ANALYSIS

Other application and websites with search functions were studied to see the different ways one can facilitate finding desired places or products. Especially websites and applications that allow the user to filter the results based on different requirements and booking functions were observed.

6.4.1 FINDING THE LOCATION OF OBJECTS

Most common when searching for a way from location A to location B is that the user is asked to type in the desired destination. The application can find a way from the user's current location through the use of GPS. The route between the destinations is then shown either as a list or on a map depending on the distance; vacation searches such as airplane tickets are usually shown in lists as the map search is not that informative (Momondo), while community traffic is shown on the map as default (Västtrafik).

6.4.2 FILTERING SEARCH RESULTS

One is usually able to filter the search depending on time or location. The user is most often asked to make the selections for filtering and then the screen loads before the results are shown. It is often appreciated that the selected filters continue to be shown even after the results have been generated as this allows for easy changes as well as memory support (Spotify). Some applications also allow the user to save common searches to make them more efficient (Västtrafik).

6.4.3 BOOKING

The booking process of e.g. movie tickets or workout sessions is often simple as this is the main (and sometimes only) function of the application. Confirmation pop-ups are removed so that the user is not interrupted in the interaction flow (Friskis&Svettis). It is also desired that the user should be able to add the booking into one's calendar or get it via e-mail to be able to save the details. Applications that are meant to be used more than 2-3 times a week can usually show your current bookings (Eventbrite).

6.5 USER INTERFACE DESIGN GUIDELINES

This section briefly describes the design guidelines provided by application developers for Android, Apple and Windows phones. The guidelines have several common elements concerning user interaction even though they are formulated differently.

6.5.1 ANDROID

Android developers should design the user interface with three main principles in mind; Enchant me, Simplify my life and Make me Amazing. These principles are further explained in this section.

Enchant me

- Delight me in surprising ways: the interface should give a sense of effortlessness and provide subtle but well-placed effects.
- Real objects are more fun than buttons and menus: the user should be able to manipulate object directly on the screen to enhance the experience.

- Let me make it mine: Allow the user to personalise the interface
- Get to know me: Preferences should be remembered.

Simplify my life

- Keep it brief: Use short phrases instead of sentences.
- Pictures are faster than words: Images attract attention and can say more than words.
- Decide for me but let me have the final say: Offer the most likely instead of several choices, but make it easy to change or “undo”.
- Only show what I need when I need it: The user can get overwhelmed when shown too much at the same time, so hide the information that is not required at the moment.
- I should always know where I am: Make it easy to navigate the interface and provide feedback on tasks in progress.
- Never lose my stuff: Save everything that is created and remember personal settings.
- If it looks the same, it should be the same: functional differences should also be visible.
- Only interrupt me if it's important: People want to stay focused so avoid information that disrupts the interaction flow.

Make me Amazing

- Give me tricks that work everywhere: People like to feel that they understand and learn for themselves, so be consistent with other Android apps.
- It's not my fault: the user wants to feel smart and does not like being corrected by the app.
- Sprinkle encouragement: Complex tasks should be made in smaller steps with helpful feedback.
- Do the heavy lifting for me: the functionality should allow the user to do things they did not think they could.
- Make important things fast: Decide what is most important in the app and make it the most efficient to use. (Android Developer guide, 2013)

6.5.2 APPLE

The guidelines concerning Apple's design for human-machine interfaces are formulated for iOS developers and describe the main principles one should have in mind.

- Aesthetic integrity: The appearance of the app should reflect its purpose and functionality. If the purpose is to be functional and efficient, the app should have little decorations in order to be integrated with its function, while a game app should have much for the user to look at in order to enhance the experience.
- Consistency: Certain skills should be transferrable from one app to another to make the user feel comfortable, but they should not be copies of each other.
- Direct manipulation: The interface of the app should make use of the multi-touch interface as iOS users seldom interact with hardware buttons and expect direct interaction with the screen.
- Feedback: The users expect immediate feedback to know that the action has been registered. The app should e.g. highlight list-objects when chosen, or show a process image when there is more than a few seconds waiting time.
- Metaphors: Users are quick to grasp metaphors for the real world, e.g. a folder. Other metaphors that are frequently used in iOS are spinning picker wheels to make choices and sliding on/off switches.
- User Control: The user should initiate and control the actions made in the app. The app can suggest a path but the user should make the decision. Actions should be simple and straight forward to be remembered, and several chances to cancel an action are expected. (iOS Developer Library, 2013)

6.5.3 WINDOWS

The Windows phone is relatively new on the market and has a different way of organising and navigating through the interface. One should design to minimise typing and operate quickly. There are five main design principles to consider for Windows phone apps.

- **Pride in craftsmanship:** One should consider the details that the user will see often to give a polished expression. The grid-screen should give the content cohesion and hierarchies in font should reflect the structure, rhythm and purpose of the app.
- **More with less:** All information shown should be important with all unnecessary features removed. The use of e.g. font, scale and colour has reduced the need for icons. This also means that the content is given more space to breathe and becomes easier to interact with.
- **Fast and fluid:** The user should be allowed to interact with objects directly on the screen. Tiles in the grid should be responsive and engaging and motion animations are used to help the user understand how the app works and how to navigate in it.
- **Authentically digital:** Keep in mind that information delivery is the primary goal of graphics and avoid unnecessary wrapping. This will simplify the interpretation of the information and make the interaction more efficient.
- **Win as one:** Use a common UI model for a more cohesive user experience, and consider how you app will work across different platforms. (Windows phone design principles, 2013)

6.6 SUMMARY

As the Brand digital guidelines are not complete yet, they are used as a base for the design of the concept and help define major features such as placement of the logo and general expression. The expression of Clean, Confident and Simple is the most important element to consider during the rest of the project as it is meant to tie together every element of the application.

Elements to preserve from Volvo On Call and the mobile website are primarily the simplicity in the design of the screens and icons. List menus are most frequently used and they are designed to be easy to scan through and easy to understand. Using a muted palette is also important for the holistic expression, but as can be seen in Volvo On Call, accent colours are suitable for separating information.

Concerning the competitor analysis, filtering search results is a very common feature that allows the application to contain much information but only showing the relevant to the user. Finding the location of objects is often done using the ordinary map-functionality found in the smartphone, which means that the appearance of this is not possible to affect.

The design guidelines provided to developers from all OSs are very extensive but allow for creativity as they are described on a high level of abstraction. All put emphasis on the importance of feedback and cohesion of design between different applications as this is important for the overall impression of the device. The user should always feel in control over what is happening and the interface should be easy to understand but efficient to use. It is also important to make the interface reflect the purpose and functionality of the application.

7 GOAL FORMULATION

In this chapter, the goals of the booking application concept are defined. A core sentence describing the goal of the application was formulated to define what the application should be really good at (Windows application design, 2013). The sentence takes into consideration results from previous chapters that have helped define what is most desirable in a booking application for corporate smartphones.

The application should be really good at finding available rooms for the user's meetings in order to facilitate the daily work.

From this core sentence, one can define certain features of the application:

- It should be easy for the user to find a room within a limited future. The application is not meant to replace the computer based interface, but complement it and the functionality can therefore be limited in order to suit the screen size and user experience.
- Directions to a room should be available in some form so the user is literally able to find the room.
- The user should be able to find a room that suits his/her needs.
- The application should be suitable for usage on the move, e.g. if the user meets a group and they go around to look for an available room.
- It should be efficient enough to be used on a daily basis.
- The application should not disrupt the user's daily routines.



Figure 12. Expression board illustrating the desired visual and functional expression of the application

7.1 EXPRESSION BOARD

An expression board was constructed with the Brand digital design guidelines in mind. It is meant to express the design voice of Clean, Confident and Simple and can be seen in figure 12.

The colour scheme represents the intended overall colours for the application, except for accent colours that may be used to enforce information separation or feedback. The confident aspect of the design voice is represented by the beauty of simple design and movement. The desired flow of interaction is shown through the allusion to water. Water was chosen as a theme as it gives association to flowing movements and cleanliness. It is powerful but sensitive at the same time, which is a desirable description of a user interface for touch-screens.

7.2 PERSONA

The first persona is based on statistics from a project that sent out questionnaires to all permanent staff at Volvo Cars Torslanda, as well as observations made by the author (Leesman Index, 2013). The second persona is formulated to represent a new employee at Volvo Cars Torslanda.

Persona 1 - Anders

Anders has been working as a crash simulation specialist at Volvo Cars since 1995. He describes himself as 46 years young with a curious mind for trying new things and enjoying the good in life. He spends most of his work days in his office building where he moves around about 50% of the day to work with other people in teams and go to meetings. He is comfortable at work and enjoys the change of location and social interaction that comes from the team work.

Anders likes to think of himself as being an early adopter when it comes to technology and he likes to have the latest smartphone and computer at work. The building he works in uses the VROOM system which he thinks is beneficial when it comes to sorting between a large quantities of rooms. However, it is frustratingly hard to find available rooms and the interface looks dated. He is very interested in applications for his smartphone, especially if they make his life a little bit easier. Anders imagines that the booking application will make his day more efficient by making sure that the rooms are utilised more efficiently.

Persona 2 - Anna

Anna is 27 years old and has been working at Volvo Cars for about seven months as a business analyst. She works in close connection to the design team which is something she finds very interesting. As a business analyst, she spends much of her time meeting with different teams and users to extract user requirements and she likes the changes in setting that comes with it. However, she is not very comfortable when being in other buildings as she has a hard time finding her way. Asking for directions is something she does not like doing.

Anna is not very into technical equipment like the newest type of laptop or phone, but she likes when the design is innovative and elegant. For her, technology is something she uses to reach her goals and it should help her efficiently without any complications. She would be interested in the application as it would help her book meetings in unfamiliar buildings and find her way without having to ask for help.

7.3 SCENARIOS

Based on how the current systems are used, three scenarios were constructed to serve as inspiration for the handling of the application.

7.3.1 UNSCHEDULED MEETING

Anders and his team of 4 have decided, with 20min notice, to meet at his desk so they can discuss a problem that occurred during the latest crash test with the XC60. After talking for about 10min, Anders realises that they should probably move to a conference room as they would be able to discuss more efficiently if they had the opportunity to use a computer with a larger screen or projector.

So, he takes up his iPhone 4 with the "VCC room finder"-application. With just a few clicks, he is shown the available rooms near him. There are only 3 available at the moment; the first one suggested is one that he usually books as he likes the view from the windows, but it is only available for 30min. The second and third one are available for 1,5 hours ahead which is better. One of them was not available in the computer version of the Outlook system as it is a restricted access room and can therefore only be booked in advance by executives.

Anders chooses to book the restricted room as he finds it exciting to sit somewhere that he normally has not access to and because it looks much nicer. He and his team go to the room by following the directions given by the application as they have not been there before.

7.3.2 MEETING WITH COMMITTEE MEMBERS

Anders has a meeting with a steering committee about once a month. As the invited participants are the same every time, he has chosen to make a meeting profile in the booking application on his smartphone. He has chosen how big the room needs to be, what kind of equipment they usually need and in which building they want to meet. All in in order to make the search for rooms more efficient.

The need for a meeting arises about 2 weeks in advance so he thinks there should be plenty of available rooms to choose from as long as he is willing to be a bit flexible with the time. As he has already added the participants in the meeting profile, he selects it to see the next available time in all participants' calendars that will coincide with a room being available.

Unfortunately, there is only one time available in two weeks, and that is on Friday at 4pm. As Anders expects the committee members to be as keen on a meeting then as he is, he chooses to see if there are more possibilities the following week. He discovers a time on Tuesday at 9am the following week and books that instead.

7.3.3 USER INTERVIEW

Anna has been asked to hold an interview with some of the workers at the factory in order to get their opinions on the manufacturing processes of the new V40. The team leader has booked a room in the TK-building and invited her to join.

The day before the meeting, Anna uses the smartphone application to investigate where this conference room is and how she should get there. She discovers that it was further away than she expected, but she should be able to make it in time from the meeting before. She gives herself 25 minutes to get from PV to TK so that she will have time to prepare once she gets to the room. Thanks to the application, she finds her way without having to ask for help and can successfully interview the workers.

7.4 MAIN FUNCTIONALITY

An important part of the goal formulation is defining the main functions of the application so that they can be prioritised in the concept design. One main function is chosen to provide a clear focus, and three complementary functions the user should be able to use with great efficiency.

1. Book a meeting – the user should be able to efficiently book a meeting based on certain requirements such as number of seats and available equipment. It should also be possible to invite other participants.
2. Find available rooms at the moment – If the user is looking for a room at that particular moment for an unexpected meeting, or wishes to see if anyone has cancelled their reservation at the last moment.
3. See personal meetings in the near future – Ability to see a list of the nearest places to meet. If the user is on the way to another building and forgets which room he/she was going to, it is easier to take up the smartphone than the laptop.
4. Provide directions to rooms – Many users have experienced problems with finding their way to a meeting they have been called to, or are reluctant to book a room they are not sure the location of.

The prioritisation is primarily based on the project definition and user interviews to make sure that the user's needs are taken into consideration.

8 REQUIREMENT SPECIFICATION

This chapter describes the requirements and guidelines worked out in the research phase. They are divided into three categories to make the document easier to overview and search through. The categories are described below with examples from the requirements (R) and guidelines (G) specification. The full set of requirements can be found in appendix 8.

8.1 FUNCTIONAL

The functional requirements are supposed to define the basic functionality of the application, e.g. that it should be adapted for html5 coding and be synced with the Outlook calendar and contacts. These specifications describe the minimum functionality of the application and how it is adapted to the limitations. The following are examples of three functional requirements.

- Possible to search for available rooms (R). This requirement originates from the project specification as this is supposed to be the main function of the application. It should be possible for the user to search for an available room for a meeting and the user's specific requirements should be considered.
- Help the user locate a room (R). During the interviews, it became apparent that it can often be difficult to find the room one is supposed to go to. Therefore, some way of helping the user find a specific room was requested.
- The concept should be suitable for html5 coding (R). As the staff at Volvo Cars uses many different types of smartphones, the concept should be suitable html5 to be compatible with many different operating systems. The implications of this is e.g. that the interface should be designed so the use of hardware buttons will not be required.

8.2 HANDLING

These requirements describe how the user is supposed to interact with the application. They are meant to encourage a logical handling that is both expected and desired, e.g. by minimising the need for the smartphone keyboard and providing clues as to what the user is supposed to do next. The application should also be designed for one handed use as the user might be carrying additional items when moving.

- The use of the smartphone's keyboard should be minimised (R). This requirement was discovered during the system research as many applications avoid forcing the user to type in information. This is due to that typing often requires a two handled grip, as well as the fact that the keyboard takes up about half of the screen.
- Hierarchical navigation structure (R). When studying the Brand digital guidelines, it was discovered that all digital communication devices at Volvo Cars should apply this type of navigation structure.
- Allow for quick and smooth navigation through the system (G). This guideline was formulated to facilitate the use of the application and make it more efficient.

8.3 DESIGN

The design requirements take e.g. the Brand manual and Brand digital guidelines into consideration. They are focused on the visual aspects of the interface to make it understandable and pleasant to interact with. Elements like colour choices, button design and how to allow for system overview are also taken into account.

- Allow the user to acquire a sense of the environment of the room (R). In the interviews, it was expressed that some users avoid certain rooms due to the interior, which is a result of lighting, furniture, wallpaper etc. It would therefore be beneficial to be able to see e.g. an image of the room as different environments are suitable for different meetings.
- Allow for use of negative space in the interface (G). This will create an expression that suits the Brand digital guidelines and will make the interface easier to interact with as it minimises the risk of pressing the wrong button.
- Use discrete colours (G). This guideline also originates from the Brand digital guidelines as the application is supposed to embody the Volvo Cars' design principles. The new Volvo Cars mobile website mainly uses white and light grey.

9 USER INTERFACE DEVELOPMENT GUIDELINES

The main methods used in the research phase are described in the Development guidelines so that business analysts and developers involved in future application projects can extract user requirements more efficiently. The guide is divided into five sections that correspond to the different research chapters in this project; system investigation, user study, interface design guidelines, goal formulation and requirement formulation. Clearly formulated requirements are especially desired as it facilitates verification of applications when they are delivered from external suppliers. The complete development guidelines document can be found in appendix 9.

In the system investigation, the author suggests that the methods HTA, efficiency evaluation and usability analysis should be used. A short step-by-step description of how to implement the methods is provided in order to facilitate for people who have not used the method before. Examples of how results from an HTA and efficiency evaluation can look are also provided.

The user study is considered especially important as it is often not prioritised in development projects due to time and cost. However, Volvo Cars recently adopted a new way of thinking which puts the user in focus – “Designed Around You”. This is also implemented at the office through the idea of “Designed Around You @ Work”, which is meant to improve Volvo Cars reputation as an attractive place to work. At this stage, it is suggested that one performs interviews where methods like Hesselgren and SAM can be integrated, as well as use cases and ECW/PUEA. The importance of focusing on how the user would want to work is expressed in the description of how to formulate questions for the interviews, but also how to extract current problems and benefits. Volvo Cars has a template for constructing a use case, so this method is not described as extensively as the others. For ECW/PUEA, an extensive description is provided, accompanied by tables, templates and examples. This is done as the methods can be complex to use the first time, but the author’s opinion is that they are very useful in detecting use related problems.

In the chapter about user interface design guidelines, links are provided to the different OSs development guidelines as these are too extensive to summarise in an efficient way in this type of document. Furthermore, it is recommended to have some insight into the different platforms if one aims to develop an application. However, some of the extracted requirements from this project are provided. This section corresponds to chapter 6, but has been renamed as the visual elements are specified in the design guidelines while the document focuses on interaction requirements.

In the goal formulation, the reader is encouraged to use personas, scenarios and an expression board to formulate the desired features of the application. As these activities are highly creative and differs between projects, the reader is encouraged not to feel restricted.

Finally, the reader is instructed to sort the requirements into different categories depending on their origin and subject. This can be done by e.g. a KJ-analysis, but as Volvo already has useful templates for structuring requirements, no methods are described in depth.

10 CONCEPT DEVELOPMENT

In this chapter, the first concept development process and the basic navigation concepts are described and motivated. The concepts are formulated with respect to two aspects: navigation and aesthetics.

The structure and navigation of the interface refers to the way the user interacts with it and how the basic structure is built up. It also includes page transitions and other animation elements that are meant to aid the user's understanding of the system and suit the mental model. It is important that the user is able to quickly understand how to make efficient use of the system and find relevant information.

The aesthetics concerns e.g. icon design and backgrounds. These items affect the understanding of the functionality so it is important to consider how they are interpreted. The Brand digital guidelines were used in the design of these elements.

10.1 NAVIGATION

Three concepts concerning overall navigation structure are presented in this section. They are based on how users are used to navigate within common applications and how Volvo Car Corporation wants their digital communications to be structured. It was important to consider the target user as most are between 45-55 years of age and would like a high recognition factor.

10.1.1 CONCEPT 1 – SCROLL

The first concept is based on the common user interaction of scrolling. When the application is opened, the user can see the different headings of each function on the start screen. When a heading is clicked, the view expands below so the content of that function is shown. The user can then either click on another heading or choose to minimise the view and thereby go back to the start view. If another heading is clicked, the previous view is automatically minimised so that only one function is visible at a time.

The concept is based on the requirement that the user should always be able to view previous selections in an accessible way, which is important to support the short term memory. It is also designed to give the user an overview of the entire system, thereby understanding the available functionality and navigation pattern. Several applications use this type of navigation to show a large quantity of information, e.g. newspapers.

Figure 13 shows the expanded view of the concept, i.e. when all headings are visible at once. It can be noted that the function of comparing schedules requires some scrolling to the side as well, as it would look too compressed otherwise.

10.1.2 CONCEPT 2 – TABLE

The second concept has a basic hierarchical navigation structure. When the application is opened, the user is shown the functions in a grid. When a heading is pressed, the user is directed to another page where the action is performed. If the user wants to return to the start page, he/she can tap the Volvo-logo. As the hierarchy is so shallow, it will probably not be any problems with understanding the structure behind the application.

The idea is that the navigation pattern will be easy to learn for inexperienced users as it is very common and straight forward. The start screen should provide an overview of the available functionality of the system and it will be intuitive to go back to the start when another function is to be used; giving every action a clear start and finish. An overview of the concept is seen in figure 14.

10.1.3 CONCEPT 3 – CAROUSEL

The third and final navigation concept is based on the action of flicking to the side to show a different view. This gesture is used in all operating systems and the user can be expected to recognise it. There is no start-screen for this concept as the user might want to access the information directly. The user can then flick to either side to access another function, and it is possible to go all the way round in order to come back to the start view (see figure 15).

The user can tap the screen twice in any view in order to be shown a miniature of all screens at the same time, as an option to flicking through the entire carousel. This action is inspired by Android. There is also an indicator in each screen to show how many views there are in the carousel, which satisfies the requirement that the user should be provided an overview of the system. Furthermore, it eliminates the need for use of backward-functionality, which is desirable as it differs greatly between iOS and Android.

10.2 AESTHETICS

The aesthetics of the concepts consist of elements from the Brand digital guideline combined with recommendations from app-development instructions. The summation of these is presented below while the complete appearance of the concept application is described in chapter 12 – Final concept.

10.2.1 ICONS

Several icon suggestions were defined in order to see which are most identified with the functionality and to make sure that they have a uniform expression. As the space is very limited on a smartphone screen, icons can help make the interface look more spacious and give room for other information. For the booking application, the main focus is to design icons that can represent the different types of equipment available in the room search, as there can be up to 10 different items.

It is important that the icons are simple and clean so they can be clear even when scaled down. It was also decided to design them in shades of grey so they would suit the design of the interface and not draw too much attention. Certain icons relate to each other, such as phone – conference phone, and they have to be evaluated accordingly. A variety of icons designed to represent a projector are shown in figure 16.

10.2.2 DESIGN FEATURES

As the Brand digital guidelines are currently not adapted to small screens such as smartphones, certain elements were extracted so the future internal applications for smartphones will have a similar expression to the commercial interfaces.

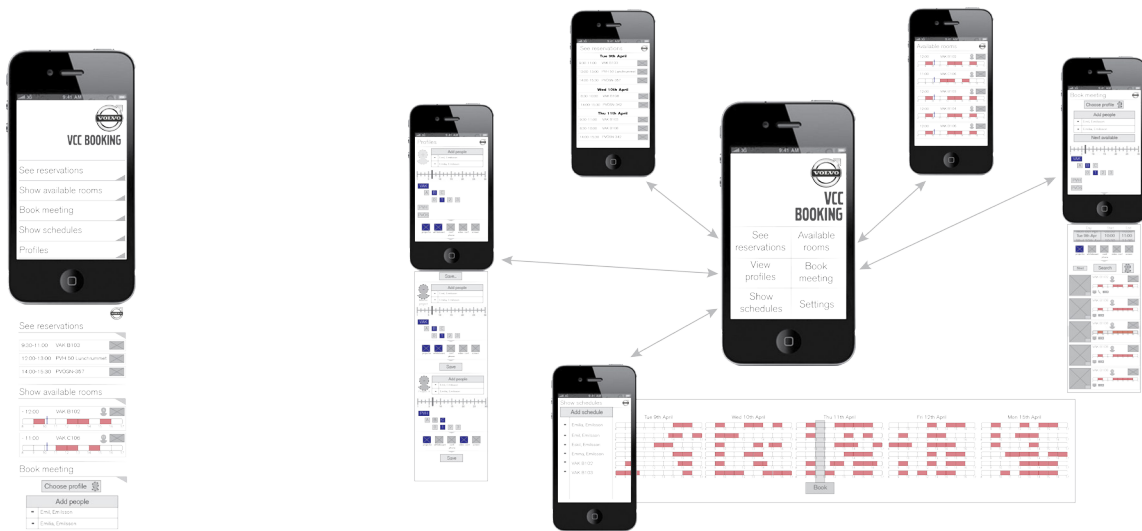


Figure 14. Expanded view of concept 2 - table

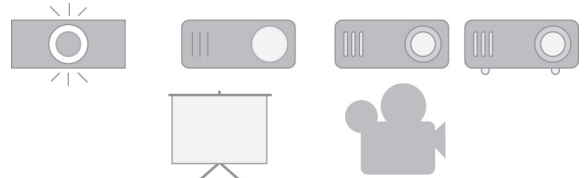


Figure 16. Icons designed to represent a projector.

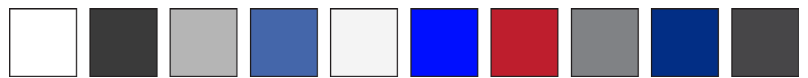


Figure 17. Colour chosen during the concept evaluation. The six to the left are from the Brand digital guidelines.

Figure 13. Expanded view of concept 1 - scroll.

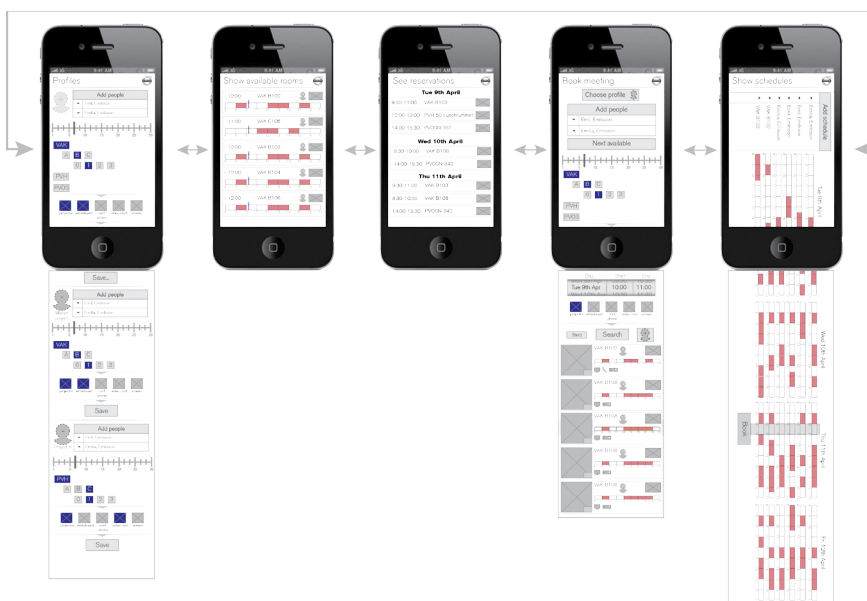


Figure 15. Expanded view of concept 3 - carousel

The concept is designed to be suitable for html5, but code can be added so the application knows which device it is being used on and adapts the font to the default setting for that particular operating system. This is relatively easy and greatly increases the sense of familiarity for the users (Nygård, 2013-03-15). However, as Volvo Cars has certain brand-specific fonts and the application is supposed to look the same independent on the OS, it was decided to use the Volvo Cars' fonts. The Volvo Sans Light font is reminiscent of both Roboto and Metro, so the users should still feel comfortable with the interface. This will also enforce the brand essence of the application.

The colours defined so far in the Brand digital guidelines describe the colour of text and action-buttons. These are white, two shades of blue and three shades of grey. During the concept design, a red swatch was added to be used for warnings such as conflicts in a search, a dark grey to be used for strokes in the icons, a dark blue derived from the iron mark logo to be used for selections, and a very dark grey to be used in the side-menu (see figure 17).

10.3 SUMMARY

The different navigation concepts are based on how the user can interact with applications on the market. The scroll concept exemplifies how to make all information available in one screen to avoid loading and making the interaction structure shallow. The table concept is constructed as most application today, in a hierarchical structure with a start-screen and separate views for the functionality. The last concept – carousel – uses a nonconventional structure for the main navigation and takes it to the extreme in order to explore the advantages and benefits. After the concepts have been evaluated, different elements from each concept will be combined to make the navigation in the final concept as good as possible.

The icons vary greatly in their design in order to find which are most easily interpreted and also to find possibilities for a cohesive look. The icons represent different levels of complexity in order to define what is necessary to be able to define how minimalistic the design can be without losing the meaning. The colours are chosen to suit the Brand digital guidelines and help the user interpret information faster. Using Volvo Cars own font is done as it is already adjusted to the desired expression and contributes to a cohesive look across the different OSs.

11 CONCEPT EVALUATION

The concepts and icons are evaluated separately so the interviewees will focus on the details of the interface instead of the differences between them. The aim is to define the best features from each icon and navigation concept and, if possible, combine the ideas to form a final concept. The reference systems are used for comparison concerning efficiency and usability.

11.1 INTERVIEWS

The interviewees at this stage of the project are chosen to represent newly employed workers at Volvo Cars, i.e. students close to graduation, as well as discussion with an experienced interaction designer. Two men and two women were interviewed in depth using an unstructured interview approach to allow for free discussions. How to apply the different navigation structures on future internal applications was also considered.

11.1.1 ICONS

The interviews begin with explaining that the icons depict certain types of office equipment that can be used in conference rooms, so as to define the context of the usage. The interviewees are then asked to state what they think the icons represent and then choose the one they consider most appropriate for the given equipment or information. The results show that the icons are quite easily understood even in those cases where the users have not had experience with similar equipment before, e.g. the conference phone. The icons found to best represent the equipment are shown in figure 18.



Figure 18. Icons perceived by the interviewees to best represent the equipment.

11.1.2 CONCEPT 1 – SCROLL

The scroll concept is considered good for reaching the desired functionality directly from the main screen. However, all interviewees agreed that it is difficult to acquire an overview of the functionality and one can easily become confused by the extensive use of scrolling up and down. A clearer separation of the functions is also desired so one can clearly see when one function ends and the next one begins. They also desire an easier way to switch between the functions as the user has to scroll up or down to reveal the other headings. Furthermore, constructing the entire application in a single view will probably make the responsiveness slow, resulting in a poor user experience.

However, the start screen was positively received as it was easy to scan through to see the available functionality of the application. It was considered easy to read when the headings are placed below each other and left-aligned.

11.1.3 CONCEPT 2 – TABLE

The table-concept is considered easy to interpret concerning how to navigate, but it seemed like “the easy way out” to some interviewees who desired a more innovative navigation pattern. It was also stated that it could become irritating having to go back to the hub when switching between functions. The hub was also considered problematic as it can be difficult for the user to scan through the different choices when they are placed in a matrix using centred text. Having six choices shown at once is expressed as too heavy for the user; it is better to divide the choices into steps by grouping functionality in a logical way. The navigation of concept 2 could become problematic for more complex applications. iPhone users are not used to hierarchies deeper than 4 levels (iOS guidelines, 2013) and one would have to insert backward-buttons next to the Volvo-logo as the left upper corner is the common placement. Android users might become frustrated as they cannot use their regular backwards-button.

On the positive side, this concept is considered the one that most users would recognise and be able to start using right away. The functions are also clearly separated which contributes to a better overview of the system’s functionality.

11.1.4 CONCEPT 3 – CAROUSEL

The way of interacting with an application mainly through flicking is not that common, only for sub-functions, and could therefore become an obstacle for the initial understanding of the usage. It would also require some kind of indication of how many views there are in total, especially if one flicks in the wrong direction and continues the entire way around to find the right functionality. For the same reason, this type of navigation structure would work best for a limited number of views, probably around 5-6 at the most. Some kind of indication of what comes next if the user flicks to the side is asked for as it would result in a better overview of the system. It is worth noting that this kind of interaction is very common for windows phones.

However, some of the interviewees like that the flicking contributed to a better flow in the interaction and it made the application feel effortless and simple. It was also good considering that the user does not have to go back to the hub to switch to another function when he/she has used the application long enough to know the order of the screens.

11.2 COMPARISON WITH REFERENCE INTERFACES

Comparisons with the reference interfaces are made concerning efficiency and usability to get further guidance as to what is appropriate to use in the final concept.

11.2.1 EFFICIENCY EVALUATION

As the concepts are not complete, the efficiency evaluation is an estimation of how many clicks it will take to perform the same tasks as in the reference systems. Only the functionality common to the systems are shown in table 7. In this evaluation, gestures such as flicking are counted in the same way as a click, but scrolling is not included. For the estimations concerning booking a room, it has been assumed that the user invites three other participants to the meeting, as booking a room for individual work rarely occurs. The action of opening the application has also been included in the count, as it was for Outlook and VROOM.

Number of clicks (Max/Min/Prob)	Book a room	Show my reservations	Show a specific room's schedule
Microsoft Outlook	20/10/15 (1) 23/12/15 (2)	4/3/3	8/8/8
VROOM	53/9/35	4/4/4	12/6/6
Concept 1	26/8/13	2/2/2	4/4/4
Concept 2	26/8/13	2/2/2	4/4/4
Concept 3	26/8/13	1/1/1	5/5/5

Table 7. Efficiency comparison between reference systems and the three concepts.

Number of uses of keyboard (Max/Min/Prob)	Book a room	Show my reservations	Show a specific room's schedule
Microsoft Outlook	6/0/2 (1) 6/0/3 (2)	0/0/0	0/0/0
VROOM	6/2/4	0/0/0	1/0/1
Concept 1	3/0/3	0/0/0	1/1/1
Concept 2	3/0/3	0/0/0	1/1/1
Concept 3	3/0/3	0/0/0	1/1/1

Table 8. Efficiency comparison between reference systems and concepts concerning the need for use of keyboard.

As can be seen from tables 7 and 8, the concepts are very similar to each other but overall better than the reference systems. This can be explained by that the user is able to save common searches and the application remembers preferences and is aware of the location of the user's workplace.

11.2.2. USABILITY ANALYSIS

The expected level of usability was analysed for each concept. It is important to note that the analysis is just an estimation as all functionality is not completely formulated in the concepts.

Concept 1 – scroll

The guessability of the first concept is expected to be quite high as all functionality is available from the start screen and the headings are easy to scan through and understand. The way of navigating through scrolling should be easy to learn as it is a common feature in many applications and websites today, so the user should be able to quickly understand how to access the information and switch between functions. However, the level of experienced user performance will not be that high since no way of making the usage more efficient is presented, except for the added functionality of saving common searches as meeting profiles. As can be seen from the efficiency evaluation above, the system potential has improved in comparison with the reference systems. As the structure of the application is simple, it should be easy for any user to go back to using it even after a longer absence, the limited functionality will probably also contribute to this factor, therefore, the re-usability is high.

Concept 2 –table

As this concept resembles how most applications are built up, the guessability is expected to be the highest of the concepts, as long as the backwards button is clearly visible. For the same reason, the users are expected to be able to learn how to navigate in the application quickly. As for concept 1, no special navigation features or gestures have been added to allow for

experienced users to increase the efficiency of the navigation. However, the system potential in comparison with the reference systems has been improved here as well. Furthermore, as the concept has a common hierarchical navigation structure, it should be easy to remember how to navigate through it even after a longer absence.

Concept 3 – carousel

For the last concept, the guessability is expected to be somewhat lower as flicking to the side is not the first thing most users think of doing when they start a new application. However, the user can quickly flick through the entire interface without having to learn which button does what. The learnability will also be lower as no initial overview of the system is presented to the user, but some users might learn quickly how to navigate through the functionality efficiently. This concept offers experienced users the possibility to quickly flick to another functionality once they have learned the order in which the views are placed, however, the benefits are still quite small when considered on a larger scale. This concept has the added benefit that the user directly accesses the first functionality without having to go through a start screen. Finally, the re-usability is probably somewhat lower as not many other applications are handled in the same way, but if clues are provided that flicking to the side is available, it should be relatively easy to re-use.

11.3 SUMMARY

Even though many of the interviewees likes the carousel concept as it innovative and new to them, the table concept is considered the one that is the easiest to understand, which needs to be prioritised in this project. The disadvantages of the scroll concept outweigh the benefits.

The evaluations show that the Outlook reference system is easier to handle when booking a meeting with many participants, mainly due to the larger screen size and use of keyboard. However, as the application is supposed to complement the system rather than replace it, such downsides can be accepted.

One major change of sorting of the functionality was made after the conducting of the interviews; the functionality of comparing schedules was removed as a main function and placed under “book meeting”. This was done as two of the interviewees found it strange that one was able to book a room from so many different places in the application. It was also estimated that the function will not be used by a majority of the users, and it’s most logical placement is as part of the meeting booking-function.

The icons chosen are a combination of the ones considered easy to understand by the interviewees and the ones that relate to the reference systems and applications with similar functionality. The aim is to have as simple icons as possible as they need to be clear even when minimised. An inner consistency was also considered, e.g. the icon for phone should be connected to the one for conference phone which, in turn, should be related to the video conference icon.

12 FINAL CONCEPT

After the concept evaluation, the final concept was developed. The navigation of the application was re-organised to suit the users' expectations and be a suitable structure for future applications. The visual aspects of the concept were clearly defined to be able to extract elements suitable for future development projects. For a complete description of the functionality of the application, see appendix 12.

12.1 NAVIGATION

The navigation of the concept is designed to consider the Brand digital guidelines of Volvo Cars, as well as suiting the user's mental model. The interviews from the concept evaluation are considered in the design of the interaction pattern. For a complete overview of the navigation of the interface, see appendix 13.

12.1.1 HIERARCHICAL STRUCTURE

As stated in the Brand digital guidelines, all of Volvo Cars' digital communications should have a hierarchical navigation structure. Therefore, a start screen where the main functionality is presented is the first thing the user sees (figure 19). The hierarchical structure is familiar to most users and should therefore suit the user's mental model.

Once a main function view has been opened, the user has the opportunity to navigate using a tab-menu at the bottom for certain functions (see figure 20). This is a common navigation pattern for all operating systems, but the placement of the tab-menu can differ; it is placed at the bottom on iOS and at the top for Android and Windows phones. In order to separate it from the main navigation at the top of the screen and prevent the user from blocking the content with the hand, it was chosen to place it at the bottom.

At the top of the screen, the user can see the headline of the function at all times. This is important as certain screens are quite similar. To the left of the name of the functionality is the Volvo iron mark and to the right is an icon indicating a list which reveals a list menu on the side when tapped (see figure 21). If the user is in the detailed room/meeting view, the logo changes into a back-button so as to know on which level in the hierarchy the user is. This way of navigation can be confusing for Android and Windows users in the beginning, but as the interface is adapted to look the same on all devices, the interaction needs to be performed on the screen.

In order to facilitate for the user during the interaction, certain additional paths have been added in the interface. When the user performs a booking, either in "Rooms" or "Book Meeting", he/she is directed to "My Calendar" in order to provide feedback on that the booking has been carried out. Furthermore, when the user chooses to select a saved meeting profile in the booking menu, he/she is directed to the "Meeting profile" view so that information about what each profile contains will be visible; the user would otherwise have to remember exactly what each meeting profile means.

12.1.2 GESTURES

In order to enable a higher level of experienced user performance, gestures were added to make certain tasks more efficient.

- When in a view that uses a tab-menu, one can flick to the side instead of tapping the next tab. This will encourage a faster interaction as it is less precise than tapping.
- When in the view showing a list of currently available rooms, the user can drag down to update the list. This is useful when the clock goes from e.g. 14:59 to 15:00. This is a common interaction in all operating systems and should be easy to understand for all users.
- If the user wishes to clear the previous search in the “Book meeting”-view, he/she can swipe two fingers back and forth three times in order to clear the search fields completely. This gesture is meant to emulate using an eraser on a white board.

12.1.3 SIDE-MENU

In order to achieve a higher level of association between the mobile website and the application, a side-menu was added which shows the same choices as the start-view but coming in from the side. This type of menu is becoming increasingly used in mobile applications across devices and the mobile website was re-designed in May 2013 to use one as well.

The menu slides in from the side when the menu-icon in the top right corner is tapped. When the menu slides in from the side, it does not cover the view completely (see figure 21). This means that the menu-icon is still visible. The user can then choose to go to another function or dismiss the menu by either flicking to the right or tapping the menu-icon again. The menu was given a darker colour than the rest of the interface in order to separate it from the content. It also has a higher degree of similarity with the mobile website for that reason.

This type of menu is used in applications across OSs e.g. Facebook and Spotify and should therefore be familiar to users of different devices. Even though it does not make the interaction more efficient by reducing the number of steps, it means that the user does not have to change to a completely different screen when switching functionality. Furthermore, it will make the application feel more current and in line with other digital communications of Volvo Cars.

12.2 AESTHETIC PROPERTIES

The aesthetic properties of the interface have been designed with much consideration to the Brand digital guidelines as well as Volvo Cars’ design voice “Clean, Confident and Simple”. The features in the application have been partly re-designed based on the instructions for computer interfaces. They should have a cohesive appearance but the concept should still look like an application for smartphones.

12.2.1 COLOURS

The colours chosen for the concept are discrete to suit the expression of clean, confident and simple. The Brand digital guidelines state certain colours that can be used for buttons and text for computer interfaces; these have been used in the concept so the user will be able to recognise some similarities between the two.

The five main colours used are white, dark grey, medium grey, grey and light grey which results in a quite monochrome expression. However, this is desirable as it is suitable to Volvo’s graphical profile and a minimalistic expression. Two additional colours were chosen to put focus on certain elements in the GUI through colour; these are deep red and dark blue.

The chosen colours can be found in figure 17 and appendix 14.

The blue colours are used to show which choices have been made and which objects are active. The red is used to indicate conflicts and other warnings as a red marking usually indicates something the user should pay attention to or be aware of.

12.2.2 ICONS

The icons used in the application are meant to be representations of reality as well as exemplifying the expression of simplicity. Therefore, they consist of shades of grey and have as few details as possible. The choice of final icons was determined by user interviews and which icons are used in the reference interfaces so the users will feel familiar with the application quickly. The complete set of final icons and their application can be found in the design guidelines in appendix 14.

12.2.3 GRAPHIC ELEMENTS

The graphic elements of the interface are summarised in this section. This includes e.g. design of buttons, aiding graphics, etc. All elements are designed with the expression of “clean, confident and simple” in mind.

The buttons are designed to be reminiscent of the ones used in other Volvo Cars’ digital interfaces. They are therefore flat in their design but with a stroke to make them stand out from the background. When tapped, the buttons change into a dark blue colour so the user receives visual feedback.

The aiding graphics of the interface are mainly meant to help separate information and show that more options are available. In the booking menu, one can see a line with an arrow in the middle pointing downwards below the choice of location and equipment. This indicates that if the user wants to choose a type of equipment that is not shown, the line can be tapped to reveal more choices. When the view is expanded, the user can also choose to minimise it by tapping the line again, which now has an upwards arrow on it.

The page transitions are designed so the user will know that it is a hierarchical structured interface. When a profile is chosen in the “Meeting Profiles”-view, the “Book meeting” view enters from the side of the screen to show that the user is still on the same level in the application.

Animations in the interface are limited. Except for transitions between menus, the only animation is connected to the picker-wheels. When the user e.g. chooses a time for a meeting by clicking “Next Available”, the picker-wheel below illustrates the process of looking for a time by rolling forward until it stops at a date and time.

A splash screen is used to inform the user that the application has been started but needs to be synchronised with e.g. an exchange server before it can be used. The splash screen is used to set the tone of the application through a playful or professional aesthetic. As is custom, the application name and company logo are displayed. An abstract image from Volvo Cars’ library of photos is used as background to complement the logo and name and create an appealing impression (see figure 22).

12.2.4 FONT

As the application is meant to look the same for all devices, it was decided to use Volvo Cars’ own fonts. In this way, the application will look similar to computer websites as well as other types of communications in commercial contexts. It is also suitable as it is a sans serif font.

As can be seen in figure 19, Volvo Broad is used as the heading for the name of the application. This is also adapted to the Brand digital guidelines. Volvo Sans is used for the headings in each main view of the application. Volvo Sans light is used in the headings on the start screen, side-menu, tab-menus and other text.

The size of most text should be no less than 7pt on a 300px screen according to the Apple and Windows design guidelines, but it can be smaller for limited amounts of text as long as it is legible. (Apple design guidelines, 2013).

12.2.5 CLUES

Certain clues were added in some of the screens to speed up the learning for a first time user. These clues are only visible the first time the functionality is used to not disturb the expert user. However, they are re-activated if the application has not been used in three weeks. There are only five different clues in the concept application and due to the level of simplicity, it not is expected that the user will need to see them when the application is used often.

The clues are blue with white text to attract attention, but are placed at the bottom or top of the page so as to be discrete and not block the content of the page. The user has but to tap anywhere on the screen to make the clue go away, which is beneficial for those that prefer to dive right into a new application without “taking the tour”.

12.3 VIEWS

The final concept has one main function, “Book Meeting”, and three supporting ones: “My Calendar”, “Rooms” and “Meeting Profiles”. How these are supposed to work and their visual appearance is described in this section.

12.3.1 START SCREEN

The start screen is designed to be easy to read and focus on the functions of the application. Therefore, only a small graphical effect in the upper right corner is used to balance the rest of the content. The logo and the name of the application are treated as graphical elements and placed at the top of the page. Furthermore, all the content of the start page have been placed above the fold so the user can get a quick overview of the complete set of functions without having to scroll (see figure 19). When the user clicks on one of the headings, the new window enters the screen from the bottom to indicate that the user is moving down in the hierarchy.

12.3.2 BOOK MEETING

The main function of the application is to find a suitable room and book it for a meeting. In order to satisfy the users, it is important to be able to sort through the available rooms using filters for e.g. equipment and location. The main view for booking a room is shown in figure 23.

Several interviewees stated that the most important thing when booking a meeting is the people you invite, therefore, adding participants is the first selection, except for naming the meeting. Based on the selection of participants, the user can then choose to find the “Next available” appointment when all are available. An alternative is to click on “Schedules” which makes a view appear from the bottom of the screen where the participant’s schedules are shown, enabling manual choice of time (see figure 24). If either of these is used, the wheel picker below is automatically set to the chosen time. However, the user can choose to set the time directly if that is the most important factor.

The user can then specify the building and floor in which to search for rooms. The place in which the user is normally situated is used as default to speed up the search. As there are many different buildings at Torslanda, more options can be revealed by clicking on the line with an arrow below. Once a choice has been made, it is marked in dark blue. If the user has chosen to invite other participants so that a majority is placed in one building, e.g. PVH, this will become the default choice in order to minimise the need of traveling.

A wheel picker is used for selecting the least number of seats required in the room. If the user has chosen to invite other participants, this will automatically change to show the number of invited.

Finally, the user is able to filter the search based on which equipment is necessary for the meeting. This functionality is included in the reference interface VROOM, but not in Outlook, which is why it is an important feature for those who still prefer VROOM. It was decided to remove certain choices of equipment which are available in VROOM as they have been outdated or are no longer used. The equipment removed are "workplace", "Docu. Camera", "Network", "CAD" and "Power PC". The five most common choices of equipment are always visible but the user can reveal more choices by clicking on the line below, as for the choice of location. When all the choices for the search have been made, the user can choose to save the settings as a new meeting profile by clicking "save as profile" next to "Search". This action will result in that the settings are saved as a new meeting profile which will allow for a quicker search in the future.

When "Search" is tapped, the available rooms that suit the filters are shown below. It is thereby possible for the user to change the search criteria directly and update the search; this also supports the users memory as the previous choices are shown.

As it is considered important that the user is able to see an image of the room, this is shown directly in the results. Other important information is considered to be the room's name, its availability during the day, number of seats and equipment. If the room suits the user, he/she taps it to go to the detailed room view from where it is possible to book it (see figure 23).

In addition, a flexible search is requested by the users as there are rarely rooms that suit their criteria perfectly. Therefore, the application also shows alternatives where the number of deviations from the search is marked by a red exclamation mark. If the room is chosen, the deviations can be seen in the detailed room view. The alternative with the least amount of deviations is shown at the top. If there are no alternatives that suit the search perfectly, a message stating this will be shown before the alternatives to give the user feedback (see figure 25).

12.3.3 CALENDAR

As it is important for the user to know where the next meeting is, a calendar function has been included in the concept (see figure 26). From this view, the user can see information about the nearest meetings such as time, location, subject and equipment in the room.

A distinction with a dark blue stroke has been made between the meetings booked by the user and the ones he/she is invited to. In this way, the user is reminded to cancel bookings. During the interviews, it was described as a problem that people often forget to cancel the bookings as it has to be done in two separate systems when using VROOM. It was therefore prioritised to make it easy to do so in the concept. If the user is not the booker of the meeting, it is instead possible to decline the invitation so the booker is aware of that the user is not attending.

When a booking is tapped, the user is directed to a detailed view of the meeting (see figure 27). From here, it is possible to see further details of the meeting, such as a map of where the room is located and who has scheduled the room before and after the meeting. It is also possible to see who has accepted the meeting invitation so the user will know who to wait for until the meeting can commence. Furthermore, it is possible to reschedule the meeting if the user is the booker. If “Reschedule” is tapped, the user is directed to the booking view where the meeting’s previous settings are filled in.

12.3.4 ROOMS

It is very common for the staff to meet up somewhere, e.g. someone’s desk, and then go around looking for an available room nearby. A function that shows available rooms near the user is therefore included in the concept (see figure 28).

The first tab which shows the available rooms in a list is the first one shown. The rooms’ names and number of seats is considered most relevant to know, as well as a bar indicating the room’s availability during the day. When a room is tapped, the user is offered to book it directly via a pop-up. A picker-wheel gives the user the opportunity to book the room from the current moment and until the room is occupied by someone else.

In the second tab, the user is able to search for a particular room’s schedule. This is beneficial as most users have favourite rooms they prefer to use as they are e.g. close to them or have a nice interior. The user has to use the smartphone’s keyboard to type in the name of the room he/she is looking for. When the desired room’s schedule is shown, the user can mark a time to book. This is done by dragging the top and bottom and finally tapping the marking to book it.

The third tab allows the user to see the currently available rooms on a map. This will inform the user of in which part of the building the available rooms are located. The functionality has been described as desirable during the user interviews, even though there is a problem with knowing which floor the room is on and how to get to it.

The function is constructed to show rooms available close to the user’s default position. The rooms are sorted according to their proximity to the user, with the closest at the top. If there are no rooms available in the user’s building, a message will indicate this and suggest that the user chooses another building. Even if the user is most likely only interested in a room in his/her own building, the added function prevents the view from becoming a dead end in the interaction. It may also be the case that the user is currently in another building and can wish to change location for that reason.

12.3.5 MEETING PROFILES

The final function of the concept is the possibility to save common searches as profiles. This is beneficial for users who often have meetings with similar room requirements or participants.

The view is quite similar to the booking menu so the user will recognise the functionality and understand it. When creating a new profile (see figure 29) the user has the opportunity to add people to the meeting profile and then choose settings such as location and equipment. The only difference to the booking view is that date and time have been excluded. When the user clicks on “save”, he/she is asked to name the profile before it is saved.

In the “Meeting profiles”-view, previously saved profiles are shown so the user can use, edit or delete them. If the user wants to change a saved profile, confirmation is needed before the previous settings are overwritten. This is also required for deleting a preset as they are

both irreversible actions.

In order to make the use of the application efficient, the user can also choose to book a meeting based on a saved profile directly from the meeting profiles view. When “Use” is clicked, the user is directed to the “Book Meeting” view where the settings have been filled in according to the profile.

12.4 SUMMARY

The final concept is designed with a hierarchical structure with a start-screen, as this is considered the easiest to understand and the one most used by applications on the market. The tab-menu functions like the carousel is used to show different types of information concerning the same object.

The functionality is limited to what is most desirable and most likely to be used on a daily basis. The user wants to find a room for meetings, which is what the application is designed to do very well despite the circumstances of the user’s situation. The main functions chosen are “Book Meeting”, “My Calendar”, “Rooms” and “Meeting Profiles”. The navigation has been designed to make the interaction as efficient as possible while making sure that the user understands the structure behind the application.

The dark blue accent colour is used to accentuate choices and active parts of the interface, but also to mark which slots in room schedules are already booked as this will remind the user of the Outlook system. The interface in general does not use many different colours as it is designed for the expression Clean, Confident and Simple, and the greyscale from the Brand digital guidelines has been used. Bookings that have not yet been confirmed in the schedule are slightly see-through to differentiate them from other bookings.

Gestures are used in moderation due to the target group, as well as making it easy and efficient to use even for first time users. Time consuming animations are not considered suitable due to the frequency with which the interface is supposed to be used.

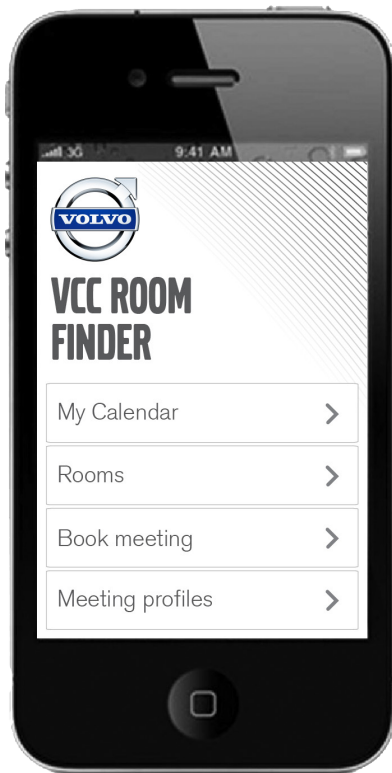


Figure 19. Concept start screen.



Figure 20. Room information when choosing from the results from a search in "Book Meeting".

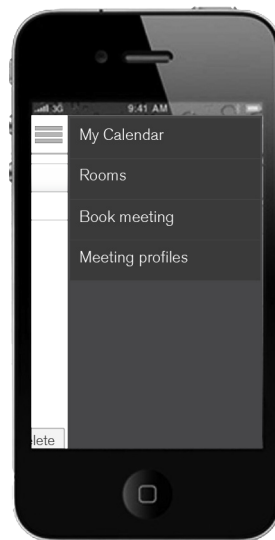


Figure 21. Side menu.



Figure 22. Concept splash screen.

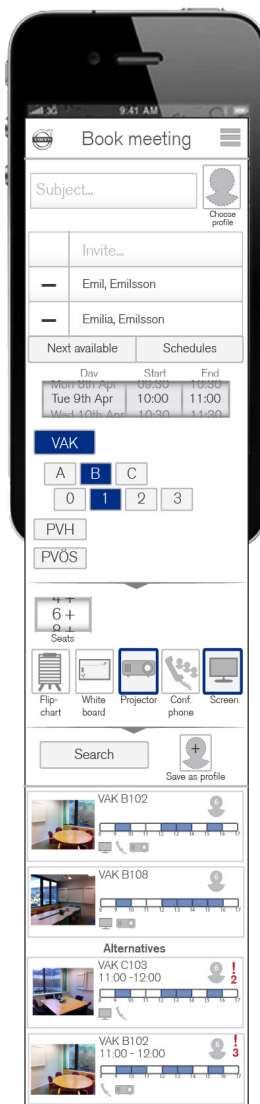


Figure 23. "Book Meeting" view.

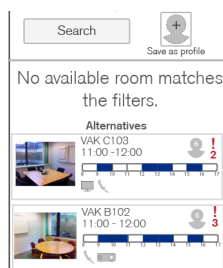


Figure 25. Feedback when rooms match the search.



Figure 24. Comparing schedules view in "Book Meeting".

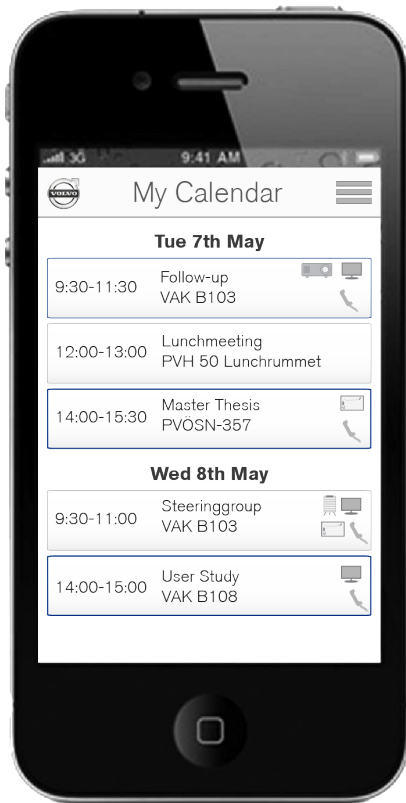


Figure 26. "My Calendar" view.

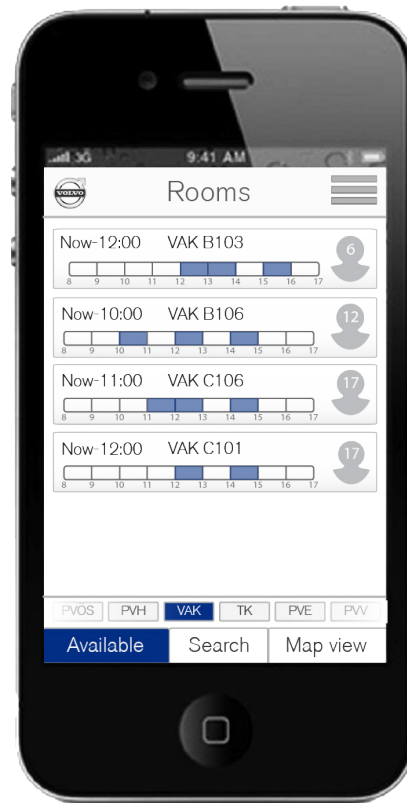


Figure 28. "Rooms" view.



Figure 29. "Meeting Profiles" view.



Figure 27. Meeting details view as shown when the user is the booker.

13 FINAL CONCEPT EVALUATION

A final evaluation of the finished GUI was performed in order to compare it with the reference interfaces. This involved the construction of several HTAs followed by an efficiency evaluation, as well as a usability analysis and interviews.

13.1 HTA

The HTAs are constructed to get an overview of the use of the system to be able to compare it with the reference systems. The example in figure 30 describes the actions performed when booking a meeting, as this is the main function of the application. The complete set of HTAs can be found in appendix 15.

As can be seen from the figure, the number of sub-tasks is less as all choices are made in the same view (unless one uses the function for comparing schedules). The interaction is straight forward and the next step in the interaction is always available to the user, which will contribute to an easier interaction than in the previous interfaces. Furthermore, it is easier for the user to skip choosing filters than it is in VROOM, which can speed up the search. The added functionality of saving common searches as meeting profiles will speed up the search even more as several steps can then be excluded.

In general, fewer sub-steps are required in the concept application than in the reference systems. This will hopefully contribute to an interaction that is easy to learn. Functionality that is not frequently used has been hidden to facilitate for the everyday usage.

The only problem with the HTA evaluation is that the user invites participants through the smartphone's default contact application, which creates a certain level of uncertainty as these can work quite differently depending on the OS.

13.2 EFFICIENCY EVALUATION

The efficiency evaluation is based on the results from the HTA and describes how many clicks or uses of keyboard are required to perform the tasks in the interface. For the function of booking a meeting, the count is based on the user inviting three other participants, as for the evaluation of the Outlook system. The results can be seen in figures 31 and 32.

In comparison with the efficiency evaluations of the reference systems from Chapter 4.2, one can see that the number of clicks is generally lower than for both reference systems. The count marked with (2) for the concept is based on the usage of a meeting profile in order to facilitate the filtering. It is important to note that Outlook does not allow the user to filter the search based on e.g. equipment, which is why the concept has a higher count for booking a meeting.

One of the guidelines for the construction of the application was to minimise the use of the smartphone's keyboard as it takes up a great amount of space on the screen and can be

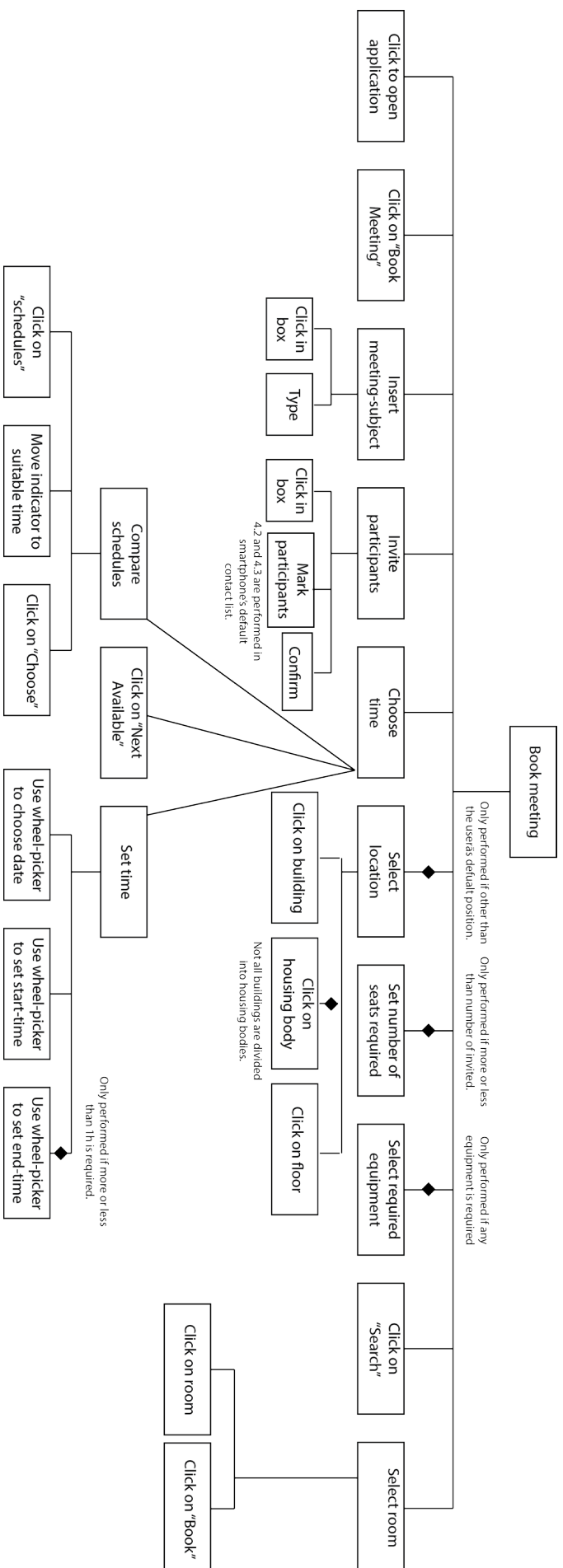


Figure 30. HTA illustrating the task of booking a meeting using the concept application.

Final efficiency evaluation number of clicks

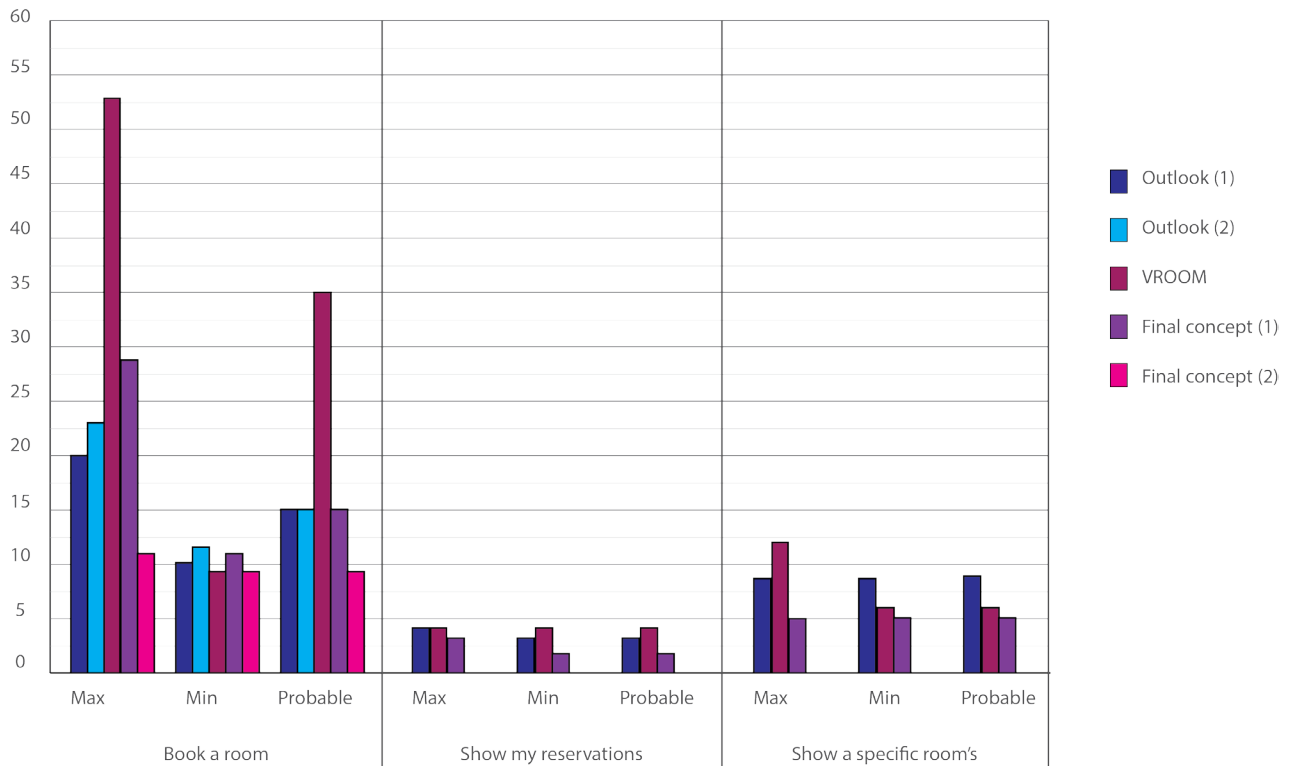


Figure 31. Diagram showing a comparison between the concept application and the reference systems concerning the number of clicks necessary to complete the tasks.

Final efficiency evaluation uses of smartphone's keyboard

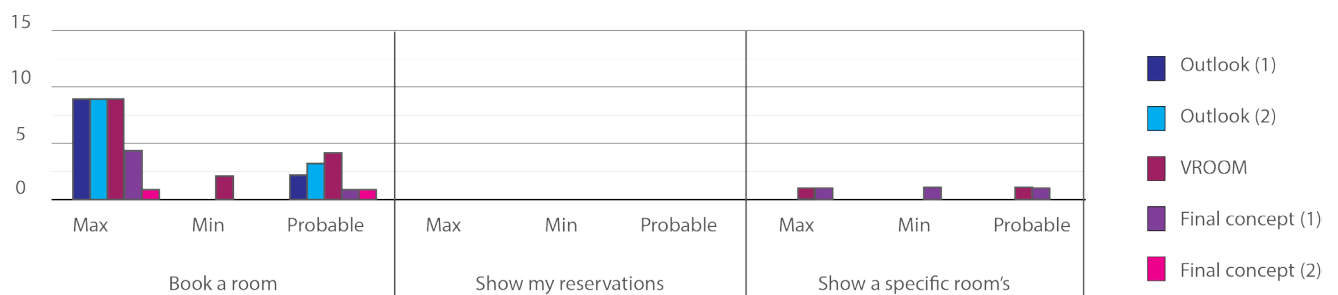


Figure 32. Diagram showing a comparison between the concept application and the reference systems concerning the number of uses of a keyboard necessary to complete the tasks.

difficult to use with only one hand. However, it was hard to eliminate the need for it when the user has to state the subject of a meeting or search for a room. It was suggested that a picker-wheel could be used for selecting which room's schedule to show, but due to the vast amount of rooms available, the option was deemed ineffective.

In general, the comparison with both reference systems shows that the application is more efficient to use for all functions included, especially considering that it is possible to filter searches based on location and equipment.

13.3 INTERVIEWS

In order to get feedback on the final concept's appearance, five persons with differing background were interviewed; three women and two men between the ages of 24 and 45. Two were chosen to represent newly employed staff that has had no experience with the reference interfaces, and three were experienced users at Volvo Cars Torslanda. The focus was not a comparison of the application with VROOM and Outlook as the application has limitations on functionality due to the software and limited screen size. Furthermore, the application is represented by images which do not allow interaction. The interviews were of a semi-structured character to make sure that the interviewees answered certain questions concerning aesthetics and appeal of the GUI. The questions asked can be found in appendix 11.

13.3.1 REPRESENTATIVES OF NEWLY EMPLOYED STAFF

The interview with the two persons that have not used either Outlook or VROOM showed that the headings of the start page are highly understandable. The visual design of the interface gave associations to Volvo as a result of colours and design. The design was also described as consistent through all screens which gave a positive impression.

The functionality was considered relevant as one often requires the use of certain equipment and is interested in the physical environment of the room. Especially the ability to save common searches as "meeting profiles" was appreciated as it reminded the users of the benefits of creating texting or e-mail groups. The amount of information shown in each screen seemed appropriate without feeling cluttered. One of the interviewees is an iOS user and another uses Windows, but the placement of the tab-menu felt logical to both.

Suggestions for improvements were minor changes such as enhancing the distinction between meetings booked by the user and meetings one is invited to in the calendar view. Somewhat more blue in the interface was asked for to make it more colourful, but concerns were expressed that it might make the interface appear cluttered. The fact that Android users might be frustrated as the phone's hardware buttons are not available was also commented as problematic for this type of application.

As a whole, the interface was described as classic, familiar and clean which are all desirable for this application.

13.3.2 COMPANY EMPLOYEES

The general reaction from the company employees selected was very positive, especially concerning the functionality of the application. Many have felt that both VROOM and Outlook have their limitations and think the application will complement Outlook well. The headings of the start-screen were highly understandable and appropriate to the functionality behind them.

The overview of the application felt cohesive and expressed the Volvo brand visually, mainly

due to the choice of colours and square design of buttons. The functionality felt appropriate and the filters used for searching for rooms include what one needs to know before booking. The strongest positive reactions were to the availability of maps and building blueprints that enables one to find the booked room. Most of the interviewees also expressed that they would probably make use of all the functionality if it was available – so nothing felt unnecessary.

Doubts were expressed concerning the efficiency of inviting other participants as it can become complicated to search if one has many contacts, but the functionality was still appreciated. One interviewee also desired more space left blank and more blue to make it appear more like a smartphone application. The decision of using the Volvo fonts was also commented on. It was said that it could become problematic with the responsiveness and scaling to different devices. According to the author's investigation, it should not be a problem as html5 is part of CSS3 which has the fonts embedded in the style (www.w3schools.com, 2013).

As a whole, the interface was described as informative and simple, which are both desirable.

13.4 USABILITY ANALYSIS

The usability analysis is based on the expected use of the system. This is a combination of the author's thoughts and the feedback from the evaluation interviews. It is important to note that the analysis is based on screenshots and not a functional application.

- **Guessability:** The guessability of the application is expected to be quite high due to the overview of functionality presented initially to the user and the naming of the functionality was considered highly understandable by the interviewees. It also contributes that the number of screens has been limited and the number of clicks has been reduced in comparison with the reference interfaces. In addition, using icons and aiding text has been proved to speed up the user's understanding of the interface more than either or. The fact that the application is designed to remind the user of other Volvo Cars interfaces and common interaction patterns for smartphone applications results in a high value. Clues have also been added to help the user understand how to use the system efficiently the first time it is opened. However, it is difficult to predict to what extent the user has interacted with other smartphone applications before. (9/10)
- **Learnability:** Due to the limited amount of functionality, the learnability of the application is predicted to match the reference interfaces. Even though it might be harder for some to use an application instead of a computer, the similarities between both the application and the reference systems should mean that the user can quickly get familiar with the interface and recognise functionality and wording. The inner consistency of the application is also expected to contribute as wording and icon-design has been considered. (9/10)
- **Experienced user performance:** As the application is meant to be used often by the majority of the users, the experienced user performance is highly important and is prioritised in the application. The user is able to do a quick search by skipping steps in the filtering options. It is also possible to create meeting profiles that enables a more efficient search without making it less relevant. The value could be increased further by the use of gestures, but due to the high average age of the users, and the desired availability for first time users, this was not extensively used. (8/10)
- **System potential:** As can be seen in the efficiency evaluation, the concept application often matches the Outlook system in number of steps and clicks, despite offering the user the option of filtering results by e.g. equipment. The user is able to skip steps and still acquire results, which was very important for the interviewees. (9/10)
- **Re-usability:** The application provides the user with an overview of the functionality

which will aid in remembering how to use it. As the application contains a limited number of functions and provides clear paths of interaction, it is expected that the user will not require much time before understanding how to use the system again. (8/10)

The analysis shows that the application should be easy to use in comparison with the reference interfaces. Certain qualities are similar but the combination of high guessability and experienced user performance gives it an edge in the comparison (see table 9).

System	Guessability	Learnability	Experienced user performance	System potential	Re-usability	Total
Outlook	6	7	9	8	7	37/50
VROOM	8	9	3	6	9	35/50
Concept	9	9	8	9	8	43/50

Table 9. Usability comparison between reference systems and concept application.

13.5 REQUIREMENT FULFILMENT

The requirements from Chapter 8, were used to evaluate how well the concept application suits the expected outcome of the project. The results can be seen in figure 33.

The partly accomplished requirements are those that had to be de-prioritised in order to fulfil others which were more important. This is also true for the requirements classified as possible to accomplish, but these would require more changes than the previous. Those requirements that were not accomplished and are not considered possible are mostly connected to technical limitations such as the precision of the phone's GPS. Functionality

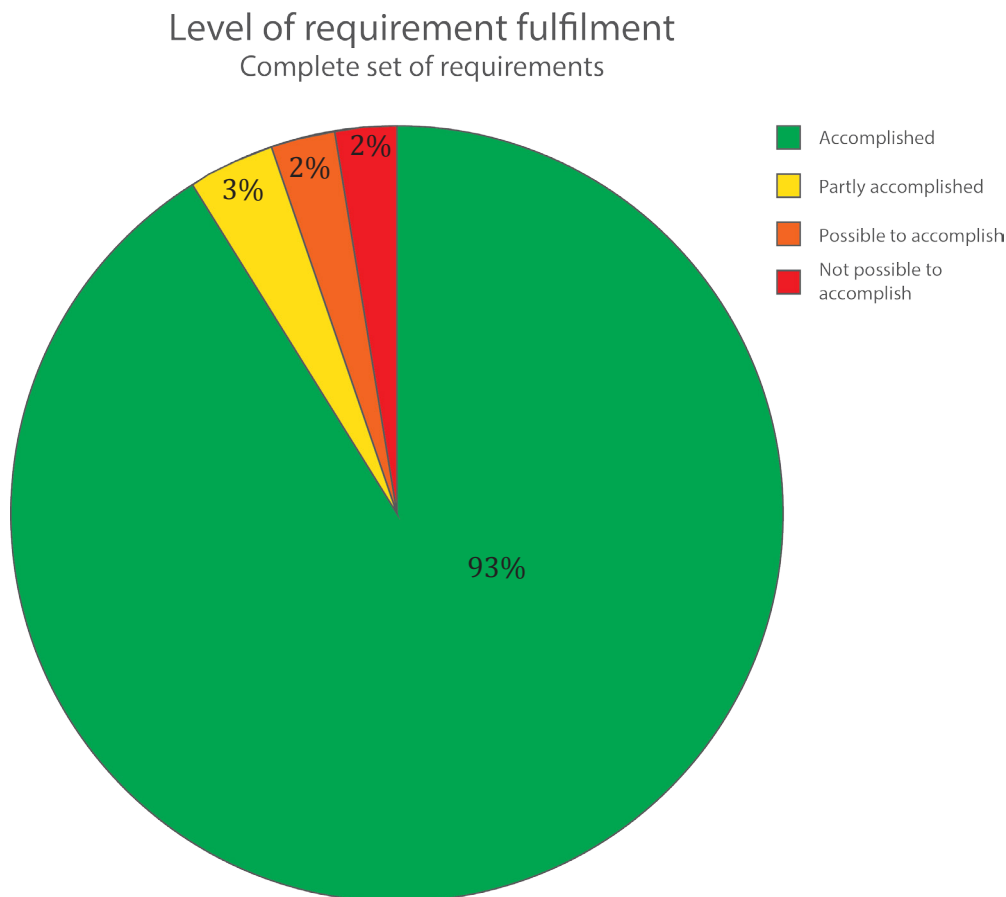


Figure 33. Pie chart illustrating the percentage of fulfilled requirements.

connected to this requirement will have to wait until the technology has developed further, but are suggested for future updates of the application.

As can be seen from the graphs, the application fulfils most of the requirements formulated. Only a very small number are not possible to accomplish and the choice to only partially consider some is motivated by their origin, priority and other guidelines. Overall, the concept application suits the requirements very well and can be considered successful.

13.6 SUMMARY

The evaluation of the final concept shows that it is very suitable for the intended purpose and matches the requirements set earlier in the project well. According to the interviewees, it is easy to understand and the appearance is suitable for the functionality and target user group.

The usability analysis shows that it has clear advantages compared with the reference systems and the efficiency analysis supports this. Even though the application makes it possible to filter through many different types of equipment, it is still deemed efficient compared to both Outlook and VROOM, which only has certain parts of the same functionality. The HTA shows further that the interaction with the application is considered easier than for the reference systems as there are fewer alternatives and a clear path of interaction.

A drawback of the application is e.g. that one still has to use the smartphone's keyboard sometimes, which can be frustrating as it most often requires two hands and more concentration as well as the fact that it takes up a lot of space on the screen.

The requirements that are not fulfilled mostly concerns technological limitations for the application, but it might be that these can be added in the future to make the application even better.

14 GRAPHICAL USER INTERFACE DESIGN GUIDELINES

This chapter describes the formulation of the graphical features that are described in the design guidelines. The design guidelines are meant to provide directions when designing future internal applications so that all have a similar expression and interaction pattern. How to handle specific elements such as the iron mark, colours and navigation is described. The different elements are first described separately, the application developed in this project is then used as an example of how the different screens can look when the elements are implemented correctly. The complete guideline can be found in appendix 14.

14.1 NAVIGATION

A hierarchical navigation structure is chosen as it is the most common navigation pattern for smartphone applications. It is also stated in the Brand digital guidelines that all of Volvo Cars' digital communications should use this structure.

The navigation is implemented so that the start screen is the hub from where all functionality can be reached, which also provides a good overview of the application. However, certain shortcuts are provided to improve the usability of the concept application. Such shortcuts should be encouraged as long as they do not interfere with the normal navigation or confuses the user. The benefits of a hierarchical navigation include that the user has probably had experience with it before.

14.2 THE IRON MARK

The restrictions on how one is allowed to use the iron mark are quite sufficient as they are. Therefore, only certain adaptations were made to suit the smaller screens of smartphones. It was e.g. decided that it is not required that the mark is visible in the top left corner at all times, as this is the most logical placement of a back-button. However, the same guidelines concerning size and background are used.

14.3 COLOURS

The main colours of future applications should be as stated in the Brand digital guidelines. These are modest shades of grey that blend well together and are suitable for Volvo Cars' brand identity. However, as the information on smartphone applications can sometimes need reinforcement to attract the attention of the user, certain accent colours were added to e.g. display warnings. These accent colours should be used in moderation as they pop out from the rest of the interface and can be seen as disruptive.

The background of all screens of the interface should have the same colour except for the start- and splash-screens. It should be light and uniform as to not take focus away from the content. A completely white background is chosen for the concept application so that

images and other content will not be disturbed by the background. This will also contribute to a clean expression.

14.4 FONT

The different OSs each have their own use of font for their smartphone applications; Roboto for Android, Myriad Pro for iOS and Metro for Windows. However, as this project is about developing an application that is suitable for all OSs, the author chose to recommend that Volvo Cars' own fonts are used for all text. This is beneficial as it is designed to suit the expression of Clean, Confident and Simple, and the users will be able to recognise it from other types of digital or printed material from Volvo Cars.

The Brand digital guidelines state that the fonts are meant to be considered as a graphical element that will contribute to the complete expression of the interface. This is especially suitable for a smartphone application as the amount of text is very limited as the user does not want to read, rather scan the content. In addition, using the same font independent of the device will contribute to a uniform expression for the users that have both a Samsung and an iPhone at work. It will also make it possible to use one code for all devices, thereby cutting cost from the development phase.

14.5 GESTURES

For internal applications, gestures should be used modestly as the age group of the target users has to be considered. However, a small amount of gestures that increase the usability of the interface and contribute to an intuitive yet innovative experience are encouraged. Besides regular gestures such as picking, scrolling and zooming, some gestures are defined in this project. These are defined so the interaction should have the same effect in future applications to maintain consistency between applications.

14.6 ICONS

The icons used should have a minimalistic expression, be simple and flat in their design and be obvious representations of reality. Therefore, only shades of grey are used. When designing e.g. the conference phone icon, the simplest representation of a person is used in the form of a profile. Furthermore, a phone is represented as an old stationary phone with a cord, even though this is not how the conference phone actually looks. This example is meant to exemplify how to make the icons as simple as possible and utilise the users' mental images of everyday objects.

14.7 BUTTONS

The buttons designed for the interface are quite different from most typical applications due to their flat design. Using gradients and shine to indicate which items on the screen are clickable is the ordinary way to design mobile applications. However, in order to achieve the expression of Clean, Confident and Simple, the buttons for these internal applications are flat and matte to put the focus on the content instead of the graphics.

Action-buttons such as "Search" and "Book" have been given a light grey background and grey stroke to make them stand out from the background. A small corner radius has been used so that they will not look too sharp, making the interface look temporary and professional.

Certain buttons such as the ones used for filters and tab-menus have two states – active and inactive. In order to clearly indicate this, the active buttons have a dark blue background and white text to make them stand out from the rest, enabling an overview of what is selected when e.g. choosing filters.

When a button is tapped, the user gets feedback of that the action has been registered through that the button changes colour momentarily to the same dark blue as the active state buttons. The action of being pressed down is also mimicked too suit the user's mental model.

The confirming button on the pop-ups is slightly different from the cancelling as a distinction between the two is necessary to avoid mistakes. Therefore, a blue gradient has been added to the button that confirms the action the user is about to perform. It was discovered that the placement of confirming button differed between the OSs and this adjustment is therefore further motivated.

14.8 MENUS

Two different menus should mainly be used in future applications. These have been chosen in connection to on which level they may be used in the interface. A third type of menu can be used when displaying similar options based on different filters, e.g. location of available rooms as seen in the final concept.

14.8.1 LIST

The list menu has been chosen as the main navigation as it provides a good overview of the functionality and choices. It is also highly understandable for most users and it is easy to scan through the content.

The menu should be presented after the splash-screen so as to present the functionality of the interface. The text should be in focus and all choices should be available above the fold. When the user has started interacting with the interface and wants to switch to another function, the list menu should be available via the menu-icon in the top right corner. The menu should slide in from the right when this icon is tapped and disappear when the action is repeated or when the user flicks to the side. The side-menu should have a darker appearance than the rest of the interface so that it does not blend in to the background and is clearly defined as a different element.

14.8.2 TAB

The tab-menu is used on the second level of the hierarchy. It can be used to display different views inside the same functionality, e.g. showing the availability of rooms in different ways. The functionality behind the tabs should be within the same category.

The user can choose to either click on the tabs to change view or flick to the side. The tab-menu should be placed at the bottom of the screen to avoid the user blocking the screen with the hand when tapping it. The number of tabs should be between three and five to clearly show which one is active while still making the tabs large enough to tap and not placing too many choices within one function.

14.8.3 CAROUSEL

The carousel is a different way of filtering choices but is not commonly used in applications. The carousel is mainly used to show different images, but the interaction was considered suitable as it is a fast way to choose between many different options. It also prevents an extensive use of buttons as non-relevant choices are hidden until the user needs them.

The carousel has been placed at the bottom of the screen so the user will not block the content of the view with the hand during interaction. The user can scroll and flick on the carousel to see more choices. It is important to make the bar large enough to prevent the

user from accidentally flicking outside it, thereby changing to a different tab.

14.9 SPLASH SCREEN

The splash screen for the internal applications should be elegant and professional in order to suit the situation in which it is meant to be used. An abstract image can be used as a background as long as it does not interfere with the iron mark which has to be present. If an image is used, it should only use one colour scale so the expression of clean, confident and simple is maintained. A multi coloured image will draw the attention away from the iron mark and application name. If possible, the image should have a connection with the functionality of the application. The application name should be written in Volvo Broad and be given a focus position on the screen, below the iron mark.

14.10 CLUES

In order for a first time user to learn the tricks of the interface faster, clues should be used. If the user desires, it should be possible to dismiss or turn them off in a simple way to prevent irritation. The interface should however be designed so that extensive use of clues is unnecessary.

The clues should discretely reveal shortcuts such as gestures so the user is made aware of the potentials of the interface right away. The colour of the clues should be blue with white text to separate them from the content, but opacity should be used to show that they are just temporary and do not block the content completely.

15 DISCUSSION

The discussion is divided into five sections that handle the topics: results, process, methods, sustainability aspects and further development. The result part comments on the outcomes and the validity, while the process and methods parts focus on the implementation and the usefulness of the chosen methods. Due to the nature of the project, the sustainability aspects are mainly on a theoretical level. Suggestions for future development concerns all results from the project; the application and its context, the design guidelines and the development guide.

15.1 RESULTS

The outcomes of the used methods are discussed in this section, as well as the conditions that led to them.

According to the definition of the project, the goal was to construct guidelines that will be applicable to both Android and iOS. It was discovered that some ways of interaction has become widely accepted, while others are highly specific to the OS used. It was chosen to mainly use elements present in all OSs, but some were not possible to combine. The main problem is that html5 does not allow for use of hardware buttons and Android users are accustomed to a back-button. For iOS users, there will be no significant difference between native applications concerning this particular element, but Android users might find it irritating and require a longer time to get used to it. The possibility of hybrid coding for this particular function was therefore discussed and will be considered in future development of the application. The author believes that a deeper study could help to further identify common features if the relatively new Windows phone interface should be further taken into consideration.

Another concern with an html5 application was expressed by some of the interviewees. The fact that the native experience is not as prominent and users will not feel familiar with a new application was perceived as a main problem that could cause dislike or irritation. However, as the users of the application are expected to use it often, the importance of the native experience becomes smaller. It was therefore prioritised to focus on making the application suit the Brand digital guidelines and create a “Volvo-feel”. Furthermore, creating a native app means that coding has to be done several times, which costs more money for the company.

Voice recognition was suggested in the initial phase of the project as it is an exciting way to control the phone and would enable the user to interact with the interface without the hands. However, the suggestion was ignored after some research due to the high level of inaccuracy in today’s technology. It must also be added that using voice recognition in an open office land can result in much noise and disturbances for the workers around the user. The possibility of having QR-codes on each room was also considered, but would have resulted in too much additional work for the company as well as hybrid coding to be able to use the smartphone’s camera.

The ability to book separate equipment in the application was also discarded as most conference rooms are equipped or are to be soon. When the author asked the receptionists that give out projectors, they stated that many call them directly to make a booking instead of using VROOM, and some projectors are booked permanently and placed in certain rooms.

Another discarded functionality is to book reoccurring meetings, i.e. those that are to take place with the same persons on a regular basis and are booked at the same time. This functionality is flawed even in Outlook as it is hard to find a room that is available all desired times unless it is booked approximately 4-6 months in advance. As those types of meetings are commonly planned well ahead and the application is not meant to be used for meetings so much in advance, the function was discarded.

A highly desired feature of the application is the ability to see the location of a room. In the application, this is provided through plan-sketches of the office where the room is marked with a blue colour. There are certain doubts of how realisable this is due to that there are no such sketches where the rooms are marked today. However, due to the positive response during the evaluation interviews, it was decided to keep the function in the concept and hope that it will be possible to solve the problem during the development. Providing written directions was discarded due to the vast amount of text it would require and the problem of adjusting them to the user's current position.

The efficiency evaluation can be considered somewhat misleading as it is not possible to filter the search in Outlook, but one can invite other persons to the meeting. The maximum amount of clicks in VROOM is calculated with the assumption that all equipment is desired, which is hardly ever the case. It was desired that it would be possible to filter the search more in the application so as to complement Outlook. One should therefore consider the efficiency evaluation with respect to the different types of functionality available in the systems, and the number showing the most probable amount should be considered as closest to reality.

15.2 PROCESS

The process was initially divided into two parts, the research phase and the concept development phase. This was done as the results generated were to result in the two documents: development guide and design guidelines.

It was hard to keep to the schedule in the first phase as company representatives had little time for interviews concerning user requirements and comments on the current systems. Many expressed negative thoughts about both VROOM and Outlook but had no time to participate in a proper interview. The different stages in the first phase therefore had to be performed almost simultaneously in order to collect a reasonable amount of feedback from current users.

When it came to formulating the requirements specification, it became clear that the company and I had very different ideas of how it should be formulated. In order for them to evaluate the delivery from a supplier, they desire almost solely requirements that leave little room for interpretation. Guidelines are not considered important which is different from the way I have worked during previous projects.

The concept development phase ran smoothly and there was sufficient time to schedule evaluations due to better planning after the previous experience. However, last minute changes to the final concept had to be made after a re-design of the mobile website had been implemented at the end of this project.

The final interviews gave a very positive feedback concerning the concept application and

the requirements previously stated were fulfilled to a very high extent. Certain technical limitations still remained in order to complete them all. Choosing the elements that are to be preserved for future projects gave a chance to reflect on the suitability of the interface and how to communicate it to others.

If I had the possibility to perform the project again with the experience acquired during the last months, I would prioritise finding interview subjects at the beginning of the project and allow the user study to be conducted during the entire first half of the project. Furthermore, the research phase of the project would be shorter to allow for a more thorough evaluation of the final concept, preferably using interactive elements. A better dialogue with the people responsible for the mobile website and Brand digital guidelines would also have been desired.

15.3 METHODS

The methods used were chosen to suit a project concerning development of an interactive interface and I think they have worked well overall. The relevant information was quickly identified during the system research phase and the users' demands identified in the user study.

The methods perceived as most useful were HTA, ECW/PUEA and the user interviews performed throughout the project. These provided extensive results on the overall system and the results could easily be used, especially during the requirement formulation.

It is unfortunate that Hesselgren and SAM are not suitable to be used on the concept as it would not be comparable to the functioning reference interfaces. The results would not show how the user responds to the interaction with the interface and would thus not give a fair result compared with e.g. VROOM where much of the frustration was associated with the interaction. The methods could be performed once the application has been in use for a couple of weeks so the users will have acquired some experience with it and formed an opinion. However, it takes a long time for users to become experienced with a system such as some have become with VROOM and Outlook.

It would have been interesting to interview more inexperienced users of both systems to evaluate how well they understand VROOM and Outlook initially. However, users of that kind are hard to find as the systems are widely used at Volvo Cars and cannot be accessed outside the facilities without a remote access key, and taking photos is not allowed.

In general, further evaluations on the finished application are desired to confirm the expected results of the usage.

15.4 SUSTAINABILITY ASPECTS

The sustainability aspects of this project mostly concerns hypothetical effects of the use of the application.

- The application can be used quickly instead of taking out and starting up one's computer which consumes up to ten times more energy than any of the smartphone models used by the staff (Pabi, 2013).
- If it becomes easier and more efficient to book your appointments and plan your time using the application, more time can be spent on other activities such as sustainability policies.
- As the application suggests the location that is most suitable for the majority of the participants of a meeting, this will reduce the need for traveling between locations,

which is most often done by car.

- The two guides will help speed up the development process and decrease the risk of having to complement the research. This will make projects more efficient.

15.5 FURTHER DEVELOPMENT

The suggestions for further development describe how to maintain and develop the application and guides further.

15.5.1 THE APPLICATION

- At the time of this project, the application is meant to be used at Torslanda. However, adjustments could be made to make it function in other areas as well. The validity of the icons could be investigated further if implementation was to be done in e.g. China.
- It would be beneficial if the rooms could be used more efficiently. The application would benefit from a system where the user “checks in” when the room is used so that unused bookings are deleted. However, a technical solution for this has yet to be found as all interviewees are resistant to a system that cancels your booking automatically if you forget to check in.
- The possibility to book reoccurring meetings should be investigated further as it is considered problematic even in the Outlook system.
- When a new Wi-Fi-system is installed in the buildings, the GPS location of the hubs could be registered. This would enable triangulation of the user’s smartphone making it possible to see one’s location relative to the room, thus making it easier to find.

15.5.2 GUIDELINES

- The design guide could be developed to contain general guidelines for all OSs so that they are easy to find in future development projects. It would have to be continuously updated to suit the technological advancements but it would make them more accessible and provide a good overview of what is recommended.
- During the project, an icon and graphical elements-library has been started. This will need to be maintained and updated as more applications are developed and the need for more icons and buttons increases. The plan is that it is complemented by the supplier in each project, but someone should probably be responsible for preserving the consistency when it is handed between projects.

16 CONCLUSION

The conclusion from this project concerns the final results as well as the experience of working with a project for a large company.

- The results of the project are meant to function as a base for future application development, but the problem of how to manage the icon and gesture library still remains.
- Designing an application contains much more steps than expected at the beginning of the project as one needs to consider the functionality behind the graphical interface. It would therefore have been useful to perform the project together with someone with some programming experience (which was the idea when the project was formulated).
- Even though I performed the project alone and could be flexible to changes in the process, it is crucial to book meetings with users and people responsible for current systems way in advance. Difficulty with finding a time to meet representatives of the staff was often the main hold up in the project.
- I was given the opportunity to get an insight into how the company normally orders applications from suppliers, which will probably be very useful in understanding company relations in the future.
- The need for proper methods to extract user requirements and evaluate usability was frequently expressed by the staff, which shows how companies are becoming increasingly aware of the need for it. It is interesting to see how the area of usability is becoming a competitive factor in the industry.

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Finding location of objects/maps:

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Filtering search results:

Friskis&Svettis (v. 1.4), Momondo (v. 1.3.0), go:teborg, Quizkampen (söka efter vänner) (v. 1.4), Din nya Volvo (v. 1.1.1), SF (v. 2.0.6), Best deals (v. 1.0), Spotify (v. 0.6.4), Eventbrite (v. 2.5.1)

Booking:

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1. SCREENSHOTS OF VROOM

Thursday, Feb. 14, 2013

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Bookings & Resources

Administration

Help


VROOM

Start page

VROOM start page

WELCOME TO VROOM

THE RESOURCE BOOKING SYSTEM



Find an available
Room

In location
GOT:PVH

Show calendar for
Select

My reservations one week
forward

Go

Go

Go

A room must be taken in use within 30 minutes after the reservation start time.
If not the room should be considered free to use by anyone.


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Bookings & Resources

Administration

Help



VROOM start page

Search result

Available resource list

Name	Loc.	Loc. det.	Class	Seats	Equipment
PVH301	GOT:PVH	Floor 3	1	16	Proj/55in screen, Whiteboard, Flip-chart, Network, Phone, CAD
PVH302	GOT:PVH	Floor 3	1	10	Proj/55in screen, Whiteboard, Network, Phone
PVH303	GOT:PVH	Floor 3	1	6	Proj/55in screen, Whiteboard, Network, Phone
PVH304	GOT:PVH	Floor 3	1	6	Proj/55in screen, Whiteboard, Network, Phone
PVH305	GOT:PVH	Floor 3	1	10	Proj/55in screen, Whiteboard, Network, Phone
PVH306	GOT:PVH	Floor 3	1	10	Proj/55in screen, Network, Phone
PVH307	GOT:PVH	Floor 3	1	6	Proj/55in screen, Whiteboard, Network, Phone
PVH308	GOT:PVH	Floor 3	1	6	Proj/55in screen, Whiteboard, Network, Phone
PVH309	GOT:PVH	Floor 3	1	9	Proj/55in screen, Whiteboard, Network, Phone, CAD
PVH310	GOT:PVH	Floor 3	1	14	Proj/55in screen, Whiteboard, Network, Phone, CAD
PVH311	GOT:PVH	Floor 3	1	15	Proj/55in screen, Whiteboard, Network, Phone
PVH417 videorum	GOT:PVH	Floor 4	2	8	Video conf
PVH418	GOT:PVH	Floor 4	2	8	Flip-chart
PVH5 Hörsal A	GOT:PVH	Floor 5	2	50	Proj/55in screen, OH, Network
PVH5 Hörsal B	GOT:PVH	Floor 5	2	70	Proj/55in screen, OH, Network

Select fields to display (max 6)

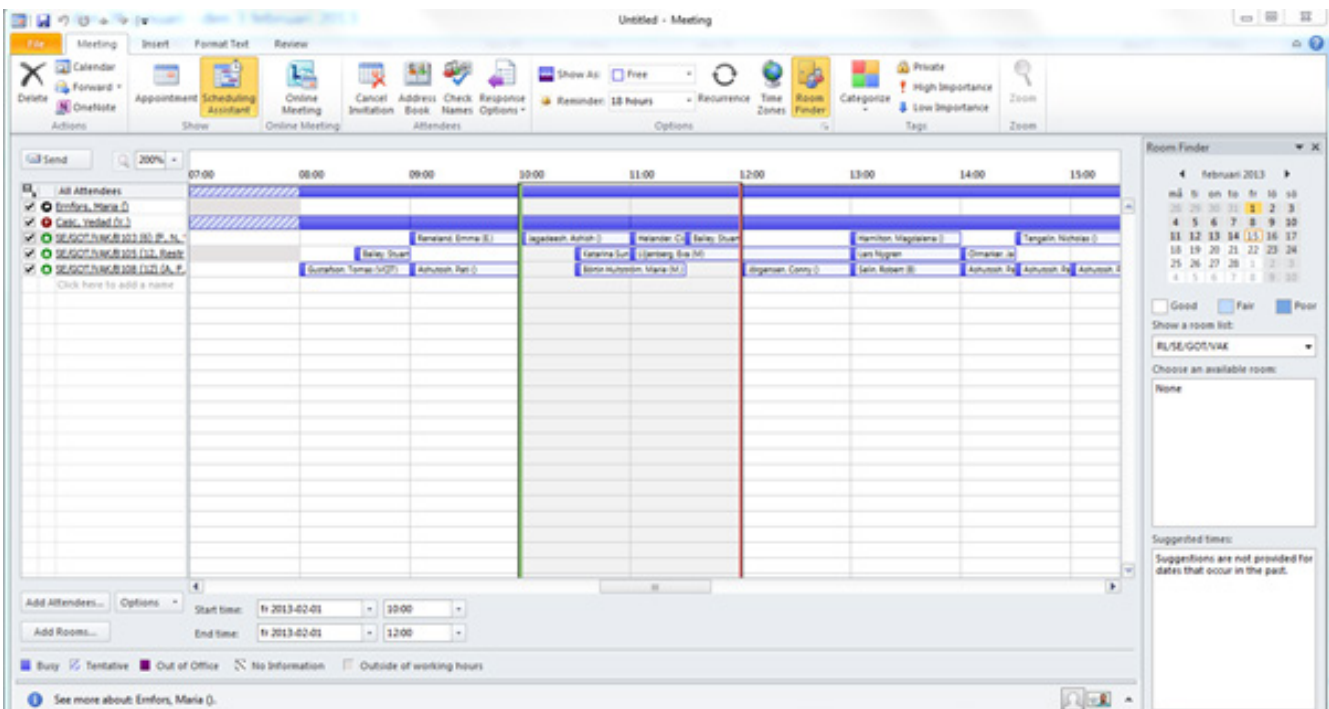
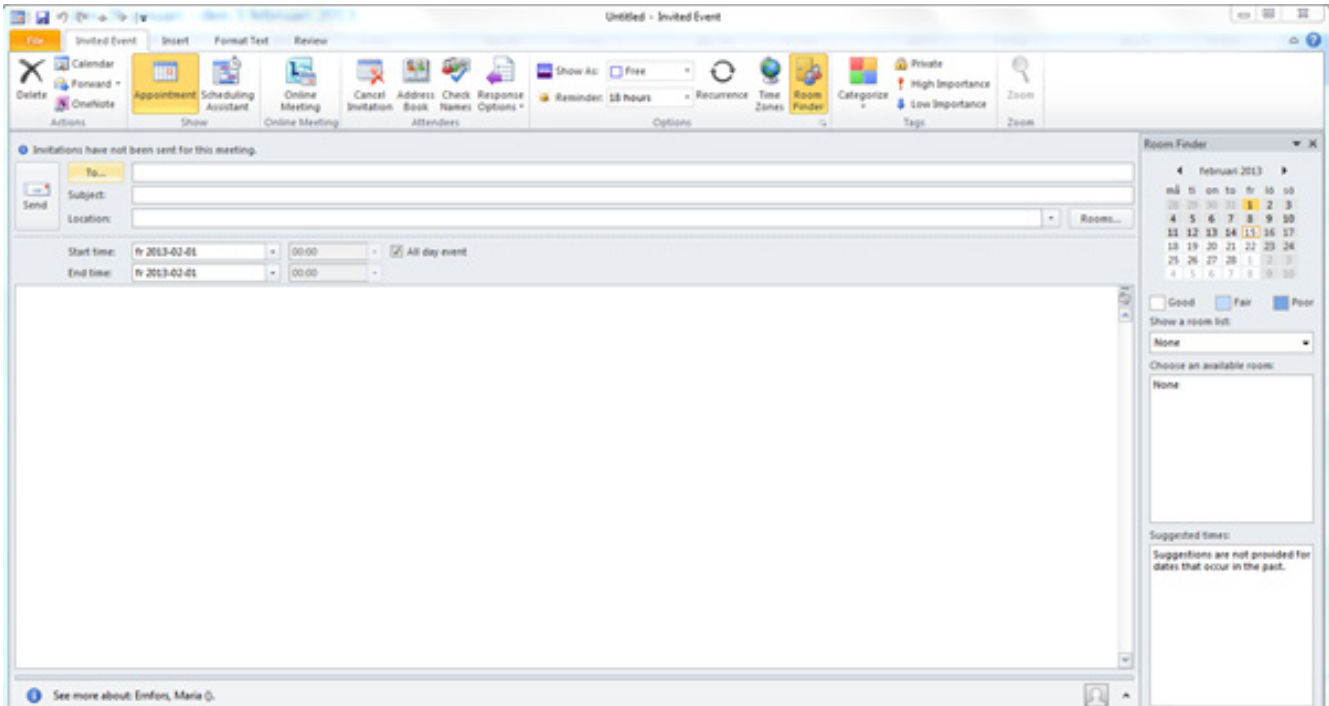
☐ Type
 ☒ Class
 ☐ Reminder
 ☒ Seats

☒ Location
 ☐ Password
 ☐ Misc
 ☒ Equipment

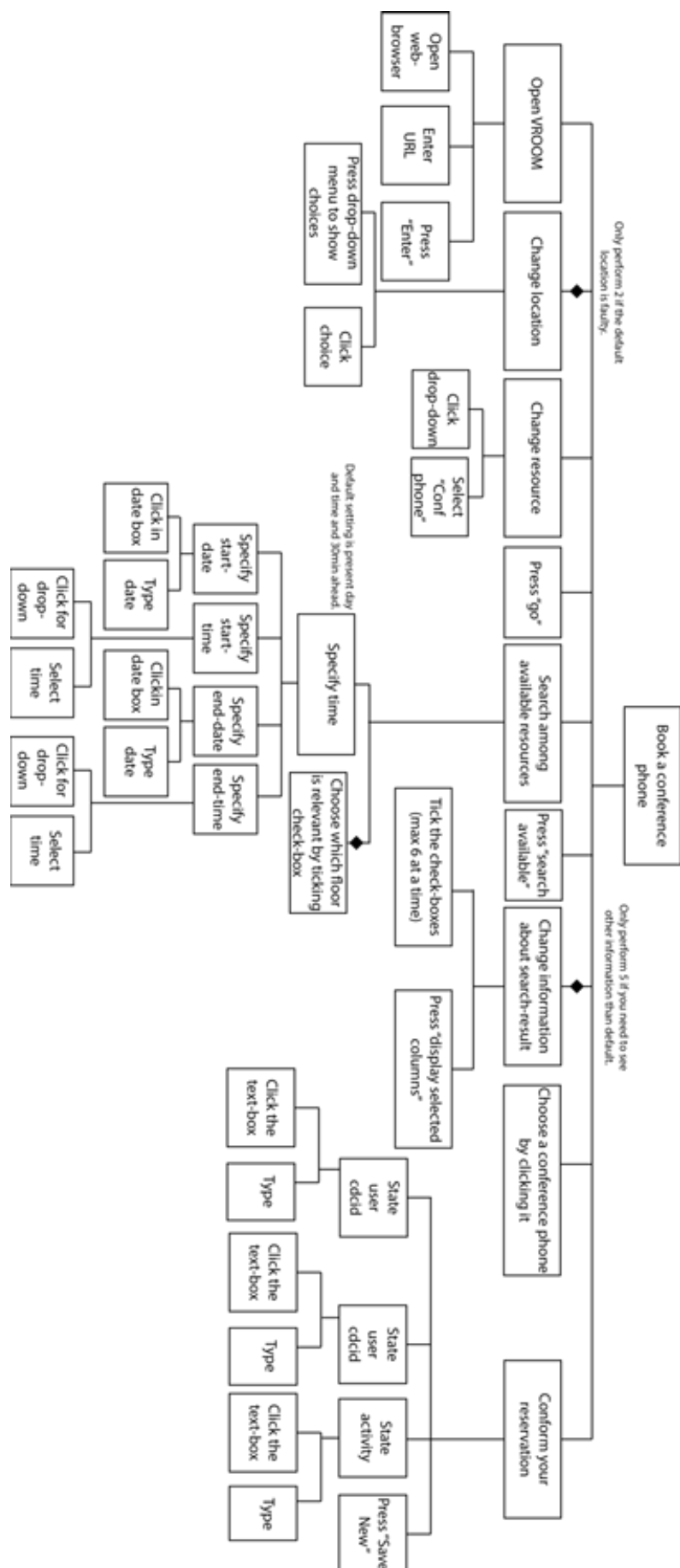
☒ Loc det
 ☐ Owner
 ☐ Room no

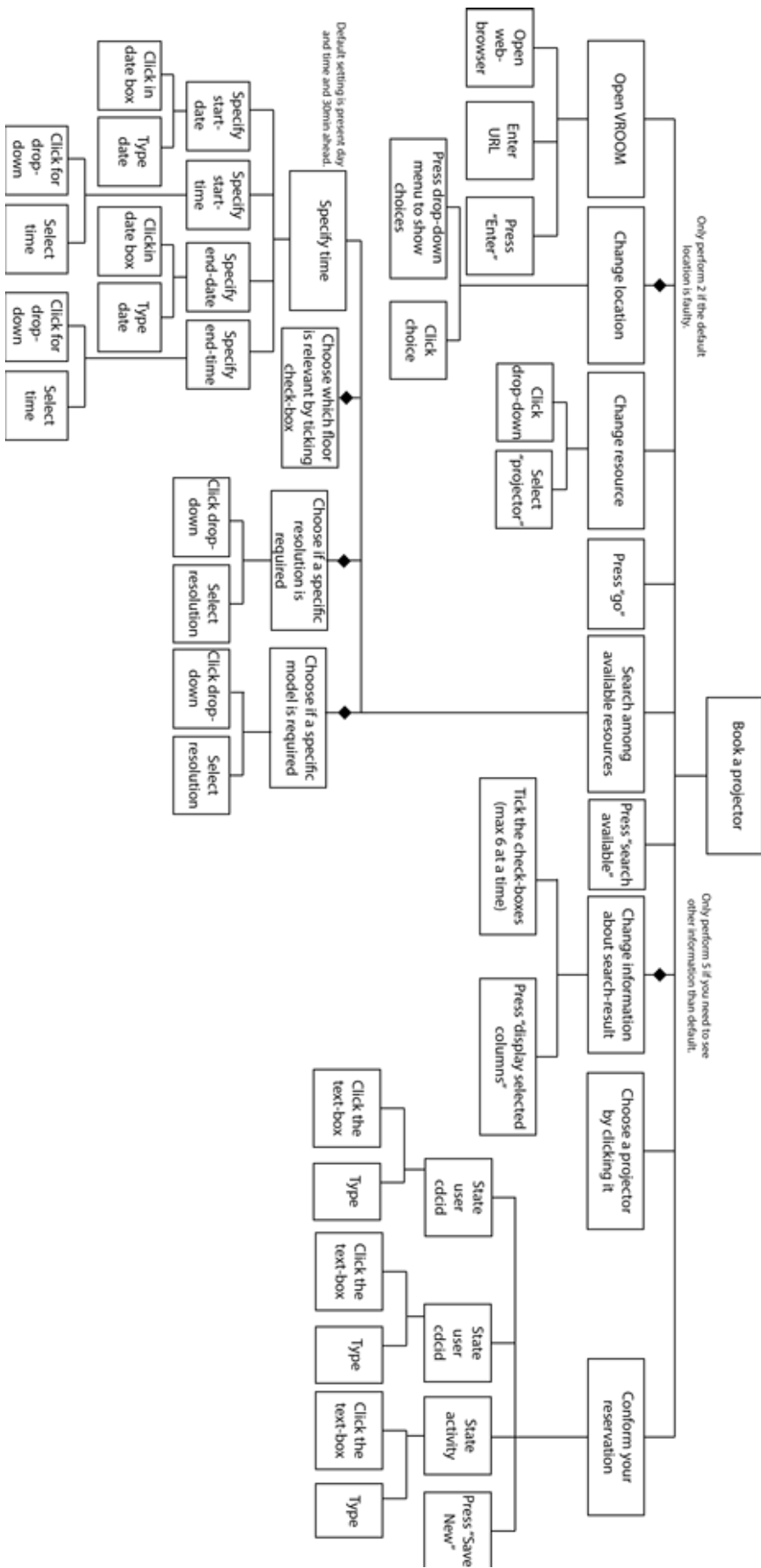
Display selected columns

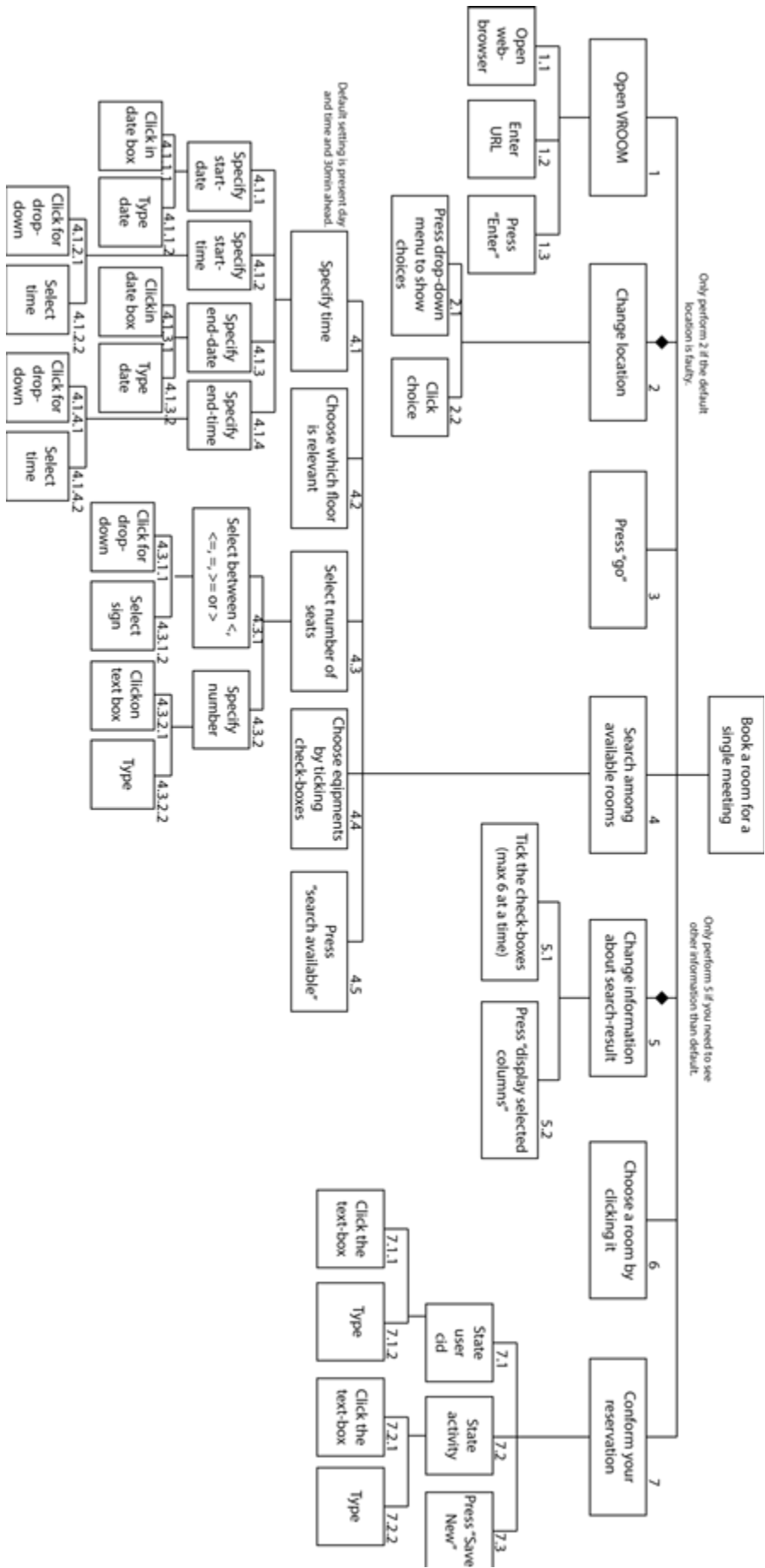
2. SCREENSHOTS OF MICROSOFT OUTLOOK

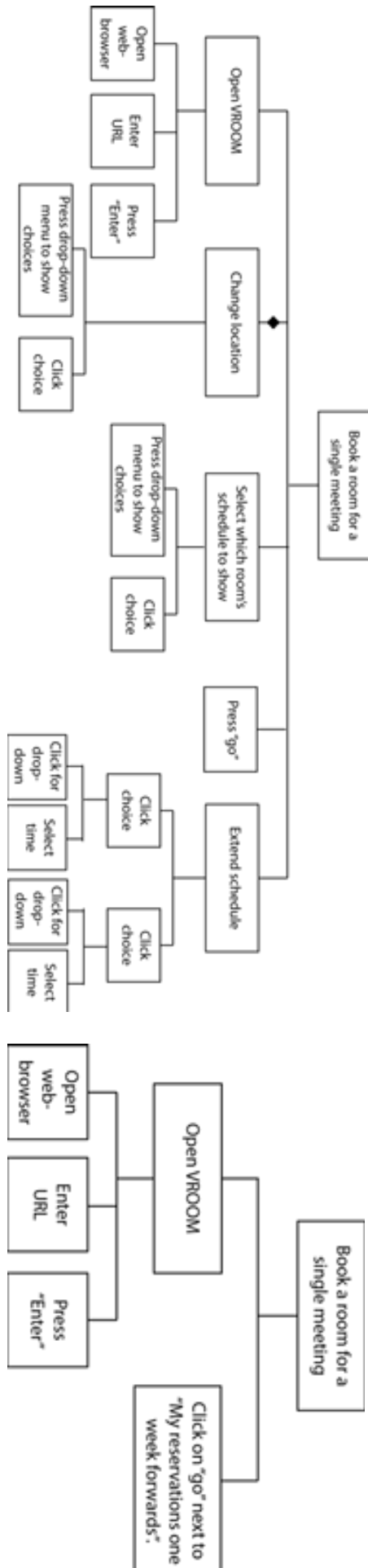


3. HTAs of VROOM

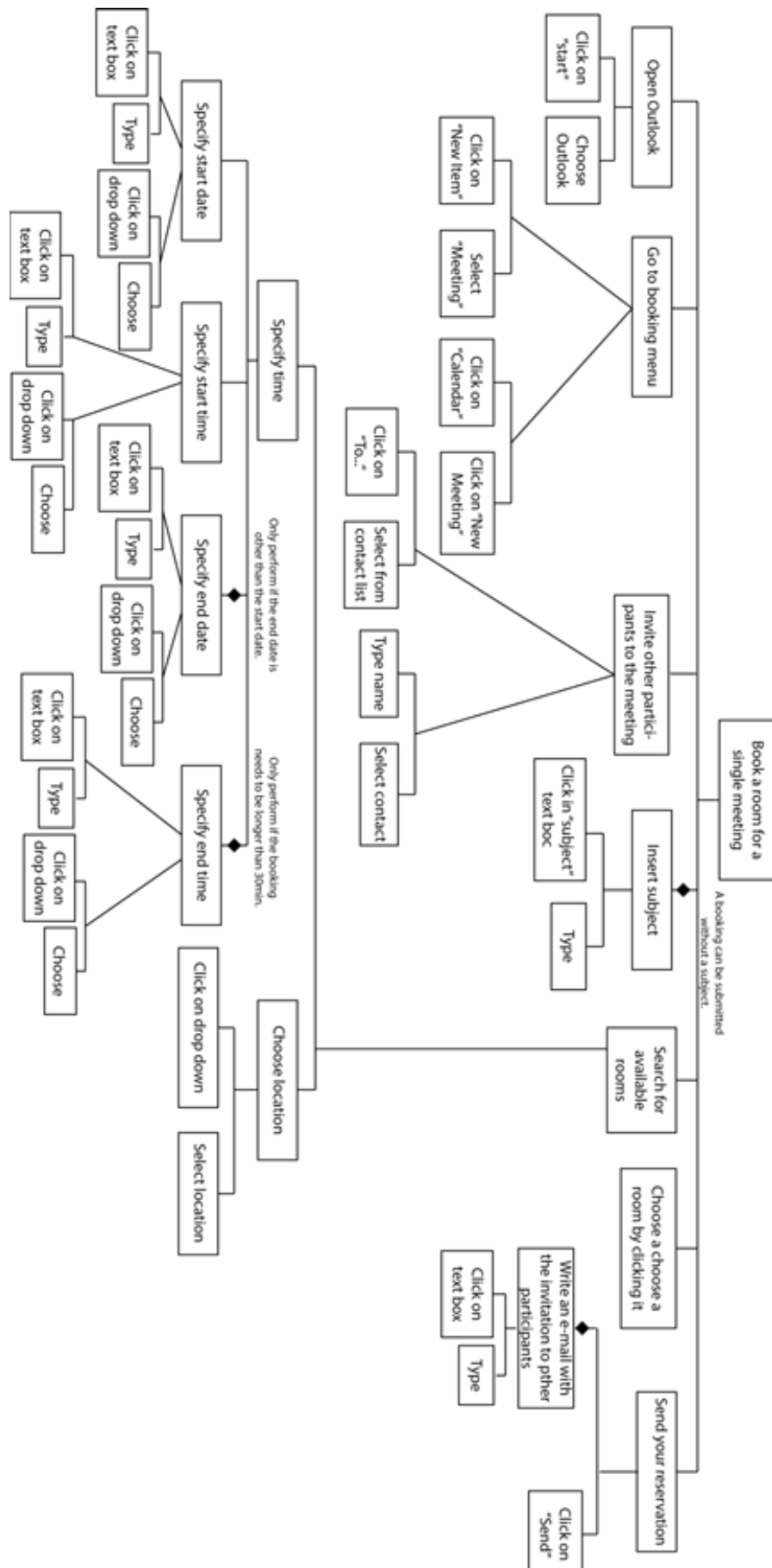




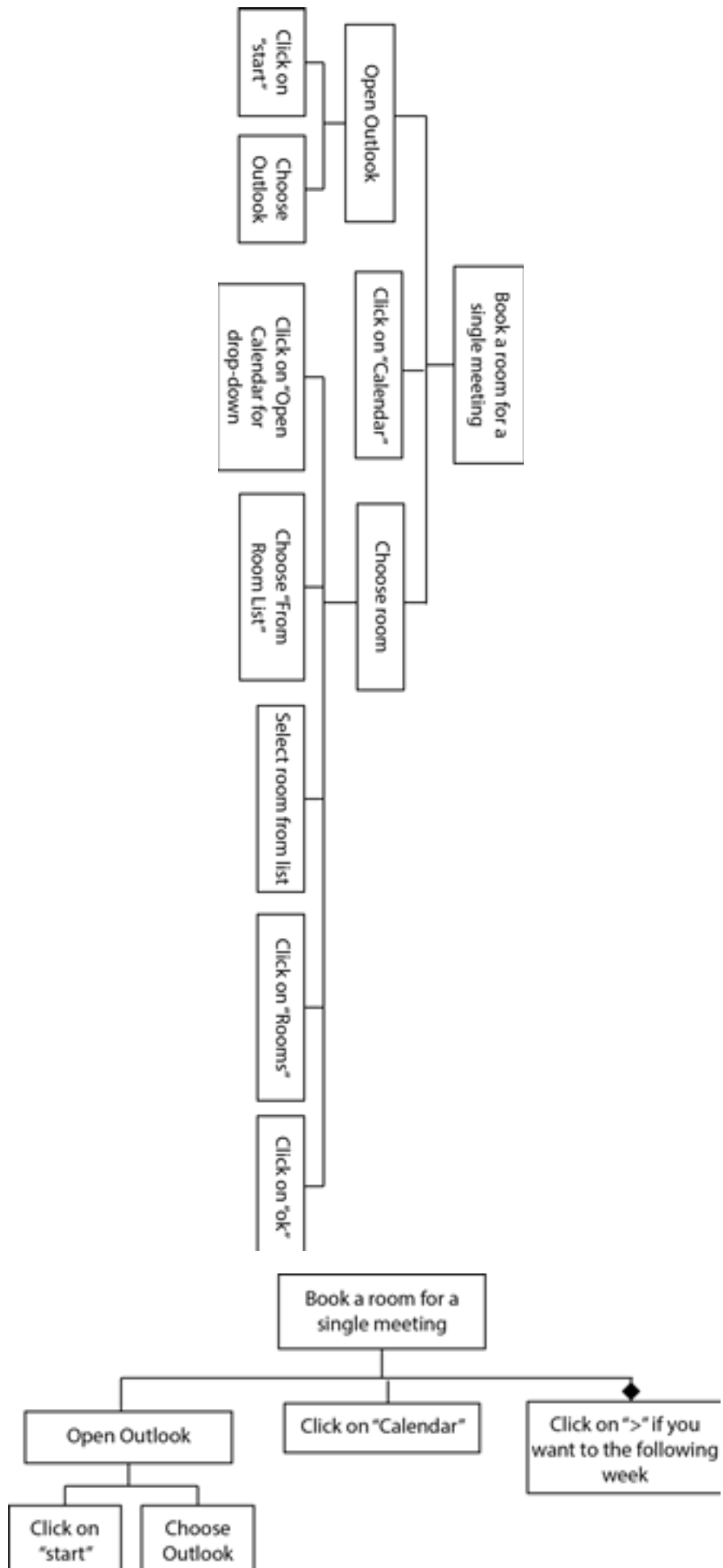




4. HTAS OF MICROSOFT OUTLOOK







5. ECW/PUEAs of VROOM

ECW				
VROOM	Task: Book a Conference phone			User, Hidden, Text and icon, Sequence, Feedback
	Success/Fail story	Potential Usability problem	Problem seriousness (1-5)	Problem type
1. Will the user know that the evaluated function is available?	Yes, the start page shows options for finding available resources.	The user might not know that not all locations have conference phones that can be booked.	4	Hidden
2. Will the user interface give clues that show that the function is available?	Yes, drop-down menus are indicated.	No problem	5	-
3. Will the user associate the right clue with the desired function?	Yes.	No problem	5	-
4. Will the user get sufficient feedback to understand that the desired function has been chosen?	Yes, the system quickly transitions to the next page.	No problem	5	-
5. Will the user get sufficient feedback to understand that the desired function has been performed?	Yes, the user is directed to the next page of selection.	No problem	5	-
PUEA				
Use Error	Error Type	Error Cause	Primary consequence	Secondary consequence
<i>Description of error</i>	<i>Which type of use error?</i>	<i>Why does the use error occur?</i>	<i>What is the direct effect of the user error?</i>	<i>What is the secondary consequence?</i>
The user can press "Go" for a location that does not have a projector and not discovering this until the search result show "no conference phones found".	A11 - unnecessary action, R1 - information not obtained, A6 - right action on wrong object.	Lack of feedback and not updated system.	User might try to change settings and filter before discovering that no conference phones exist for that building.	2 - The user is unable to find a conference phone and has to reschedule the meeting or move to another room.
Error detection	Error recovery	Consequence protection	Error prevention	
<i>Can the user detect a use error before any secondary consequences occur?</i>	<i>Can the user recover from the use error from the use error before any severe consequences occur?</i>	<i>Measures to protect from the secondary consequences.</i>	<i>Measures to prevent occurrence of use error.</i>	
3 - Yes, the user can go back to the start-page and try to find any conference phone in the building using the "show calendar for"-tool. Then the user will discover that no conference phones are registered for the building.	Yes, the user can call the administration or reception to discover the reason.	None	No conference phones are displayed under "show calendar for" in the start menu (but this is not indicated unless the user clicks the drop-down menu).	

ECW				
VROOM	Task: Book a projector			User, Hidden, Text and icon, Sequence, Feedback
	Success/Fail story	Potential Usability problem	Problem seriousness (1-5)	Problem type
1. Will the user know that the evaluated function is available?	Yes, the start page shows options for finding available resources.	The user might not know that not all locations have projectors that can be booked.	4	Hidden
2. Will the user interface give clues that show that the function is available?	Yes, drop-down menus are indicated.	No problem	5	-
3. Will the user associate the right clue with the desired function?	Yes.	No problem	5	-
4. Will the user get sufficient feedback to understand that the desired function has been chosen?	Yes, the system quickly transitions to the next page.	No problem	5	-
5. Will the user get sufficient feedback to understand that the desired function has been performed?	Yes, the user is directed to the next page of selection.	No problem	5	-
PUEA				
Use Error	Error Type	Error Cause	Primary consequence	Secondary consequence
<i>Description of error</i>	<i>Which type of use error?</i>	<i>Why does the use error occur?</i>	<i>What is the direct effect of the user error?</i>	<i>What is the secondary consequence?</i>
The user can press "Go" for a location that does not have a projector and not discovering this until the search result show "no projectors found".	A11 - unnecessary action, R1 - information not obtained, A6 - right action on wrong object.	Lack of feedback and not updated system.	User might try to change settings and filter before discovering that no projectors exist for that building.	2 - The user is unable to find a projector and has to reschedule the meeting or move to another room.
Error detection	Error recovery	Consequence protection	Error prevention	
<i>Can the user detect a use error before any secondary consequences occur?</i>	<i>Can the user recover from the use error from the use error before any severe consequences occur?</i>	<i>Measures to protect from the secondary consequences.</i>	<i>Measures to prevent occurrence of use error.</i>	
3 - Yes, the user can go back to the start-page and try to find any projector in the building using the "show calendar for"-tool. Then the user will discover that no projectors are registered for the building.	Yes, the user can call the administration or reception to discover the reason.	None	No projectors are displayed under "show calendar for" in the start menu (but this is not indicated unless the user clicks the drop-down menu).	

ECW				
VROOM	Task: Book a room for a single meeting			User, Hidden, Text and icon, Sequence, Feed back
	Success/Fail story	Potential Usability problem	Problem seriousness (1-5)	Problem type
1. Will the user know that the evaluated function is available?	Yes, the start page shows options for finding available resources and "Room" is the default setting.	The user might not know which building to book a room in (not all buildings have rooms registered in VROOM anymore as they have transitioned to Outlook)	3	Hidden, Feedback
2. Will the user interface give clues that show that the function is available?	Yes, drop-down menus are indicated.	No problem	5	-
3. Will the user associate the right clue with the desired function?	Yes.	No problem	5	-
4. Will the user get sufficient feedback to understand that the desired function has been chosen?	Yes, the system quickly transitions to the next page.	No problem	5	-
5. Will the user get sufficient feedback to understand that the desired function has been performed?	Yes, the user is directed to the next page of selection.	No problem	5	-
PUEA				
Use Error	Error Type	Error Cause	Primary consequence	Secondary consequence
<i>Description of error</i>	<i>Which type of use error?</i>	<i>Why does the use error occur?</i>	<i>What is the direct effect of the user error?</i>	<i>What is the secondary consequence?</i>
The user cannot see which buildings have any registered room in the system and can go on until the search shows "no rooms found" without any warnings.	A11- unnecessary action, R1- information not obtained, A6- right action on wrong object.	Lack of feedback and not updated system.	User might try to change settings and filter before discovering that no rooms exist for that building.	1 - The user is unable to find a room for a meeting. Might be forced to go to another building to find a room.
Error detection	Error recovery	Consequence protection	Error prevention	
<i>Can the user detect a use error before any secondary consequences occur?</i>	<i>Can the user recover from the use error from the use error before any severe consequences occur?</i>	<i>Measures to protect from the secondary consequences.</i>	<i>Measures to prevent occurrence of use error.</i>	
3 - Yes, the user can go back to the start-page and try to find any room in the building using the "show calendar for"-tool. Then the user will discover that no rooms are registered for the building.	Yes, the user can call the administration or reception to discover the reason.	None	No rooms are displayed under "show calendar for" in the start menu (but this is not indicated unless the user clicks the drop-down menu).	

ECW				
VROOM	Task: Show my bookings			User, Hidden, Text and icon, Sequence, Feedback
	Success/Fail story	Potential Usability problem	Problem seriousness (1-5)	Problem type
1. Will the user know that the evaluated function is available?	Yes, the start page clearly states "my reservations one week forward" and "Go"	No problem	5	-
2. Will the user interface give clues that show that the function is available?	Yes, the start page clearly states "my reservations one week forward" and "Go"	No problem	5	-
3. Will the user associate the right clue with the desired function?	Yes.	No problem	5	-
4. Will the user get sufficient feedback to understand that the desired function has been chosen?	No.	The feedback after clicking "Go" is slow and there is no indication of that the program is working.	3	Feedback
5. Will the user get sufficient feedback to understand that the desired function has been performed?	Yes, the user's reservations for one week forward are shown	No problem	5	-
PUEA				
Use Error	Error Type	Error Cause	Primary consequence	Secondary consequence
<i>Description of error</i>	<i>Which type of use error?</i>	<i>Why does the use error occur?</i>	<i>What is the direct effect of the user error?</i>	<i>What is the secondary consequence?</i>
The user might not believe that the system has registered the clicking on "Go" and becomes frustrated and tries repeatedly.	A11- unnecessary action, R1- information not obtained.	Lack of feedback and slow system.	The user might try to restart the program to make it work.	2 - The user does not find the information searched for (might think the system is broken).
Error detection	Error recovery	Consequence protection	Error prevention	
<i>Can the user detect a use error before any secondary consequences occur?</i>	<i>Can the user recover from the use error from the use error before any severe consequences occur?</i>	<i>Measures to protect from the secondary consequences.</i>	<i>Measures to prevent occurrence of use error.</i>	
2 - No, the same problem will occur every time and unless the user waits to see what happens, the error will not be detected.	No, the user might have to go into another calendar program to view reservations or call the reception for help.	None	None	

ECW				
VROOM	Task: Show specific room's schedule			User, Hidden, Text and Icon, Sequence, Feedback
	Success/Fail story	Potential Usability problem	Problem seriousness (1-5)	Problem type (U, H, T, S, F)
1. Will the user know that the evaluated function is available?	Yes, the start page clearly states "show calendar for"	The user had to choose the correct building in order to find the rooms. He might not know which building the room is in and can therefore not find the schedule.	4 - the room's name begins with the abbreviation of the location.	Hidden
2. Will the user interface give clues that show that the function is available?	Yes, the start page clearly states "show calendar for" in connection to a drop-down menu.	No problem	5	-
3. Will the user associate the right clue with the desired function?	Yes.	No problem	5	-
4. Will the user get sufficient feedback to understand that the desired function has been chosen?	Yes	No problem	5	-
5. Will the user get sufficient feedback to understand that the desired function has been performed?	Yes, the schedule for the room is shown.	No problem	5	-
PUEA				
Use Error	Error Type	Error Cause	Primary consequence	Secondary consequence
<i>Description of error</i>	<i>Which type of use error?</i>	<i>Why does the use error occur?</i>	<i>What is the direct effect of the user error?</i>	<i>What is the secondary consequence?</i>
The user might choose the wrong room from the list and then select "go" as he does not see it.	C1 - checking omitted, S2 - Wrong selection made	Slip - The user does not pay attention to his actions.	The wrong room's schedule is shown.	2 - The user does not find the information searched for. Might plan according to the wrong room's schedule.
Error detection	Error recovery	Consequence protection	Error prevention	
<i>Can the user detect a use error before any secondary consequences occur?</i>	<i>Can the user recover from the use error from the use error before any severe consequences occur?</i>	<i>Measures to protect from the secondary consequences.</i>	<i>Measures to prevent occurrence of use error.</i>	
5- Yes, the name of the selected room is shown at the top.	Yes, the user can go back using the return button on the web-browser. Or click on "VROOM start page" to start over.	Showing the room's name at the top of the schedule.	Having to confirm by pressing "go".	

6. ECW/PUEAs of MICROSOFT OUTLOOK

ECW				
	Task: Book a room for a single meeting (using "appointment")			User, Hidden, Text and icon, Sequence, Feedback
<i>Outlook</i>				
	Success/Fail story	Potential Usability problem	Problem seriousness (1-5)	Problem type
1. Will the user know that the evaluated function is available?	Yes, the user should be able to note that it is possible to create a meeting.	The user might not associate "New Item" with creating a meeting, or thinking that you could create a meeting via the calendar menu.	4	Hidden
2. Will the user interface give clues that show that the function is available?	Yes	No problem	5	-
3. Will the user associate the right clue with the desired	Yes	No problem	5	-
4. Will the user get sufficient feedback to understand that the desired function has been	Yes	No problem	5	-
5. Will the user get sufficient feedback to understand that the desired function has been	Yes	No problem	5	-
PUEA				
Use Error	Error Type	Error Cause	Primary consequence	Secondary consequence
<i>Description of error</i>	<i>Which type of use error?</i>	<i>Why does the use error occur?</i>	<i>What is the direct effect of the user error?</i>	<i>What is the secondary consequence?</i>
The user might not associate the clicking on "New Item" with the creating of a meeting.	R1 - information not obtained	Lack of association or an unwillingness to try the functions.	The user does not discover how to book a meeting.	2 - user cannot book appointments, can only be invited by others.
Error detection	Error recovery	Consequence protection	Error prevention	
<i>Can the user detect a use error before any secondary consequences occur?</i>	<i>Can the user recover from the use error from the use error before any severe consequences occur?</i>	<i>Measures to protect from the secondary consequences.</i>	<i>Measures to prevent occurrence of use error.</i>	
5 - The user should know that the function is available, or should eventually find the function.	Yes, the user only has to examine the interface closer and be attentive of the icons.	If the user goes to the Calendar menu, the icon "New Meeting" and "New Appointment" become available.	None	

ECW				
	Task: Book a room for a single meeting (using the scheduling assistant)			User, Hidden, Text and icon, Sequence, Feedback
Outlook				
	Success/Fail story	Potential Usability problem	Problem seriousness (1-5)	Problem type
1. Will the user know that the evaluated function is available?	Yes, the user should be able to note that it is possible to create a meeting.	The user might not associate "New Item" with creating a meeting, or thinking that you could create a meeting via the calendar menu.	4	Hidden
2. Will the user interface give clues that show that the function is available?	Yes	No problem	5	-
3. Will the user associate the right clue with the desired	Yes	No problem	5	-
4. Will the user get sufficient feedback to understand that the desired function has been	Yes	No problem	5	-
5. Will the user get sufficient feedback to understand that the desired function has been	Yes	No problem	5	-
PUEA				
Use Error	Error Type	Error Cause	Primary consequence	Secondary consequence
Description of error	Which type of use error?	Why does the use error occur?	What is the direct effect of the user error?	What is the secondary consequence?
The user might not associate the clicking on "New Item" with the creating of a meeting.	R1 - information not obtained	Lack of association or an unwillingness to try the functions.	The user does not discover how to book a meeting.	2 - user cannot book appointments, can only be invited by others.
Error detection	Error recovery	Consequence protection	Error prevention	
Can the user detect a use error before any secondary consequences occur?	Can the user recover from the use error from the use error before any severe consequences occur?	Measures to protect from the secondary consequences.	Measures to prevent occurrence of use error.	
5 - The user should know that the function is available, or should eventually find the function.	Yes, the user only has to examine the interface closer and be attentive of the icons.	If the user goes to the Calendar menu, the icon "New Meeting" and "New Appointment" become available.	None	

ECW				
Outlook	Task: Show the user's reservations			User, Hidden, Text and icon, Sequence, Feedback
	Success/Fail story	Potential Usability problem	Problem seriousness (1-5)	Problem type
1. Will the user know that the evaluated function is available?	Yes, the calendar mode is clearly visible.	The user might not see that the function is available as it is placed quite low.	4	Hidden
2. Will the user interface give clues that show that the function is available?	Yes	No problem	5	-
3. Will the user associate the right clue with the desired	Yes	No problem	5	-
4. Will the user get sufficient feedback to understand that the desired function has been	Yes	No problem	5	-
5. Will the user get sufficient feedback to understand that the desired function has been	Yes, the user's schedule is shown.	No problem	5	-
PUEA				
Use Error	Error Type	Error Cause	Primary consequence	Secondary consequence
Description of error	Which type of use error?	Why does the use error occur?	What is the direct effect of the user error?	What is the secondary consequence?
The user might look for the calendar function in the wrong place. Might not see it as Outlook has many different functions.	R3 - information retrieval incomplete	Lack of attention or not examining the entire interface.	The user's reservations are not found.	1 - the user might miss appointments.
Error detection	Error recovery	Consequence protection	Error prevention	
Can the user detect a use error before any secondary consequences occur?	Can the user recover from the use error from the use error before any severe consequences occur?	Measures to protect from the secondary consequences.	Measures to prevent occurrence of use error.	
5 - Outlook gives warnings when activities in the schedule are approaching. The user will always find the function once it has been found the first time.	Yes, the calendar mode is always readily available.	Notifications of upcoming activities.	None	

ECW				
	Task: Show specific room's schedule			User, Hidden, Text and icon, Sequence, Feedback
Outlook				
	Success/Fail story	Potential Usability problem	Problem seriousness (1-5)	Problem type
1. Will the user know that the evaluated function is available?	Partly, the calendar function is clearly visible and from there, the user can find a specific room's schedule.	The user has to click several times to open the schedule for a specific room. But once a room has been chosen, the user is able to return to it even after shutting off the computer as the calendar is saved next to the user's.	4	Hidden, Sequence
2. Will the user interface give clues that show that the function is available?	Yes, the user can interpret which action is the next one.	Could be difficult to know the next step.	4	Hidden, Sequence
3. Will the user associate the right clue with the desired	Yes.	No problem	5	-
4. Will the user get sufficient feedback to understand that the desired function has been	Yes, clues bring the action forward.	No problem	5	-
5. Will the user get sufficient feedback to understand that the desired function has been	Yes, the schedule for the room is shown.	No problem	5	-
PUEA				
Use Error	Error Type	Error Cause	Primary consequence	Secondary consequence
Description of error	Which type of use error?	Why does the use error occur?	What is the direct effect of the user error?	What is the secondary consequence?
The user might get lost in the numerous functions of Outlook and is unable to find the next step for showing a specific room's schedule.	A9 - action incomplete, R1 - information not obtained.	Knowledge based mistake - the user misinterprets the symbols and does not see the connection with the desired effect.	The room's schedule is not found.	1 - The user does not find the information searched for and has to find help or keep trying.
Error detection	Error recovery	Consequence protection	Error prevention	
Can the user detect a use error before any secondary consequences occur?	Can the user recover from the use error from the use error before any severe consequences occur?	Measures to protect from the secondary consequences.	Measures to prevent occurrence of use error.	
4 - the function "open schedule..." gives clues to its function.	Yes, the user can easily go back in the interface as it does not change screens.	None	None	

7. INTERVIEW QUESTIONS FOR USER INTERVIEWS ON REFERENCE SYSTEMS

My name is Maria, I am in my final years of study at Chalmers and I am performing my thesis here. I will begin by asking you some questions. Thank you for agreeing to this interview, I would like to record it if that's okay with you?

1. How long have you been working here at Volvo Cars?
 2. Could you please, generally describe a typical day of work?
 3. How would you like it to look? Any particular differences?
 4. Are you most often at a computer or on the move?
 5. How often do you have a need for booking a room? How often do you accept bookings made by others?
 6. How often do you have a need to book a room in another building? For what reason?
 7. How long in advance are you usually aware of the need to book a room?
 8. Which is the deciding factor when you book a room (time, place, equipment)?
 9. Do you even go around the corridors and see if there are any available rooms even though the schedule says they're all booked?
 10. Do you use the equipment available in the room?
 11. Which equipment is most important to you?
 12. Do you think about not booking a room that has more seats than you require?
 13. Do you ever book a room where you can phone or sit and work away from distractions?
 14. Would you consider being directed to a room that fits your requirements? (Instead of choosing from a list)
 15. Do you tend to book the same room(s)? Why? Is there any reason why you avoid certain rooms?
 16. What to you hope a future booking application for your smartphone can help you with?
 17. Is there anything else you wish you could do in connection to booking a room? Anything that is not possible today?
-
18. Have you previously used VROOM, Outlook or both? What are your thought about that/those system(s)?
 19. Would you please book a room in both systems and think aloud as you do?
 20. What would you say is desirable about the current system(s)?
 21. What is undesirable?
 22. Do you feel that something takes unnecessarily long time or is difficult when you want to book a room?
 23. Have you ever used your smartphone to book a room? What did you think about it/Why not?
 24. What do you think about the room's names in the system? (Easy to remember?/ Descriptive?)
 25. How often do you have a need for booking separate equipment like a projector or conference phone?

8. REQUIREMENTS AND GUIDELINES

ID	Requirements	Motivation	Priority	Origin
D01	The Volvo Iron mark has to be visible at all times in the top left corner	Stated in the brand digital guidelines	Required	Visual elements design
D02	Allow the user to acquire a sense of the environment of the room	The interviewees expressed a desire to get a sense of the room through the interface.	Required	User study
D03	The typography should be sans-serif	This facilitates reading on all limited screen such as a smart phone	Required	Visual elements design, literature study
D04	The interface should clearly display the room's availability	One of the most desired functions	Required	User study
D05	Show which equipment is available in the room	Will provide functionality that is not available in Outlook thereby encouraging its usage	Required	User study
D06	Adjusted to Volvo Cars' graphical digital profile	The application will be a part of Volvo Cars' communication devices	Required	Project definition
D07	The iron mark should have free space around it and a relatively one-coloured background.	Suited to Volvo digital design guidelines	Required	Design guidelines
D08	Apply Volvo Cars' brand voice: Clean, Confident, Simple	Should fit in with other Volvo Cars interfaces and creates a common expression.	Required	Visual elements design
D09	The difference between clickable and static elements should be clearly visible	The user should be able to see the difference between information and choices to improve usability	Required	Design guidelines (visual elements design)
D10	Easy to find rooms that are available at the current time	Frequent that people walk around and look for rooms whose bookings had not been used	Required	User study
D11	The design of the interface should allow for good overview of the available rooms	Make the system attractive and efficient to use	Required	User study
Priority 1				
D12	Highlight list objects when chosen	Clearly shows which object has been chosen	1	Design guidelines
D13	Boxes for e.g. buttons should be square with maximum 50x rounded corners	Suited to Volvo digital design guidelines	1	Design guidelines
D14	The colour(s) behind or in connection to the iron mark should be complementary to the Volvo Cars brand	Suited to Volvo digital design guidelines	1	Design guidelines
D15	Selected filters should be shown throughout the booking process	Feedback to the user	1	Design guidelines
D16	Reduce the number of screens and displays to a minimum	Facilitate navigation and understanding of the system	1	Visual elements design
D17	Locations of a room should be readily available in the interface	Frequently requested by users	1	User study
Priority 2				
D18	Provide feedback to the user why a room cannot be found	Create awareness to avoid frustration	2	Literature study, design guidelines
D19	Different types of typography and text size should be limited to a maximum of 4	Avoid the interface looking cluttered. Hard for the user to process many different levels of information	2	Literature study, design guidelines
D20	Use light and discrete colours, preferably white, off-white and gray	Suited to Volvo digital design guidelines	2	Design guidelines
D21	Make the user aware of where he is in the interface	Facilitate navigation and understanding of the system	2	Visual elements design
Priority 3				
D22	Icons and images should be flat	Maintain a simple expression	3	Design guidelines
D23	Use straight guiding lines	Graphics should be informative and discrete	3	Visual elements design
D24	Information text should be no longer than 1 sentence, calls to action should be 2-3 words	Text can easily make the interface look cluttered	3	Visual elements design, brand digital guidelines
Priority 4				
D25	Show who has accepted the meeting invitation in a good overview	Desirable so that one knows if one should wait for more participants if that might be running late	4	User study
D26	Show the "soft qualities" of the room	Many users want to see more about the room than facts like equipment and number of seats	4	User study
Priority 5				
D27	Show a clear difference between participants and room choices	Avoid confusion and separate people from resources	5	User study

	Guidelines		Appealing visual aesthetics will result in a perceived increased functionality.			
D28	The interface should be pleasant to look at			Medium	Literature study	
D29	Enable the user to acquire an overview of the system and how to navigate in it.		Increase usability	High	Literature study and system research	
D30	Design icons to be simple, distinctive and easily understood		Increase usability and speed up learning	High	Literature study	
D31	Only show important information (hide other things for later)		Too much information will make the interface cluttered	Low	Visual elements design	
D32	Information required to perform a task should be readily available		Avoid to put strain on the user's short-term memory	High	Design guidelines	
D34	Accent colours should be used in moderation and be discrete		Graphics should not take overhand of the information. Not suitable for the applications professional usage	High	Visual elements design	
D35	The main purpose of graphics is to convey/deliver information		A professional app should not make use of unnecessary graphics that may clutter the appearance	Medium	Design guidelines	
D36	All unnecessary functions should be removed to remain a simple expression		Keep a simple and clean expression	High	Design guidelines	
D37	The appearance of the app should reflect its purpose		A playful application should be colourful and interesting while a professional should be clean to appear practical	Medium	Design guidelines	
D38	Functional differences should also be visible		It two icons are similar despite having very different functionality, the user might be confused	High	Literature study, design guidelines	
D39	The constructions of the interface should convey a sense of effortlessness					
D40	Give the information and graphics space to breathe		This will make the interface more pleasant to look at and interact with	Medium	Design guidelines	
D41	Volvo Sans typography should be used as much as possible		Maintain a clean, simple, confident and effortless appearance	High	Design guidelines	
D42	Feedback should be clear and helpful without interrupting		Brand digital design guidelines	Medium	Visual elements design, brand digital guidelines	
D43	Text should be short and concise.		The user should be able to understand what is happening but should not be forced to confirm	Medium	Literature study, design guidelines	
D44	Icons should be uniformly designed with a simple expression		People do not like to read a lot of text on a small screen.	Medium	Design guidelines	
D45	Always provide information to the user of what is happening in the application		Graphics should be discrete and informative	Medium	Visual elements design	
D46	Good readability through contrast and lighting		Create awareness to avoid frustration	High	Design guidelines	
D47	Design for a minimalist expression		Easy to use the interface	High	Literature study	
D48	Make use of negative space where possible		Stated in the brand digital guidelines	High	Visual elements design, brand digital guidelines	
D49	The appearance of the interface should be adapted to Volvo Cars graphical profile		This will make the interface more pleasant to look at and interact with as the eye is given space to rest	Medium	Visual elements design	
D50	Text can be used as a complement to icons in explanatory purpose		Stated in the brand digital guidelines	High	Visual elements design, brand digital guidelines	
D51	The transitions between screens should be discrete, smooth and informative		This will speed up learning but be careful not to look cluttered	Low	Visual elements design	
D52	The icons should be designed to be representations of reality		Will help the user understand how to navigate in the interface and creates a flow in the interaction	Medium	Visual elements design	
D53	Avoid providing the user with too much information		Increases understanding	Medium	Design guidelines	
D55	Avoid providing the user with too much information		Avoid confusion and that the user chooses not to read any information	High	Design guidelines	
D56	Use consistent wording		Stated in the brand digital guidelines	High	Visual elements design, brand digital guidelines	
D57	Avoid similarities between icons and objects		Avoid confusion	High	Design guidelines	
D58	Things that relate to each other should be organized together		Increase understanding of their function, can also be used to separate functionality	Medium	Design guidelines	
D59	Show previous relevant choices and info		Increase understanding of the system and decrease load on short-term memory	High	Design guidelines	
D60	It should be easy for the user to acquire an overview of the functions available in the system		Will make the system easier to use and make the user feel in control	High	Design guidelines	
	The interaction should withstand distractions during the interactions.		A smartphone can be used on the run and the user needs to shift attention between different activities.	Medium	Goal formulation	

ID	Requirements	Motivation	Priority	Origin
H01	The user should not have to remember more than 5 units of information simultaneously	Most user have problems remembering 7+/2 units	Required	Literature study
H02	The tasks should contain fewer steps than the current interfaces	It should be easier to handle the application to encourage the use of it.	Required	HTA, ECW/PUA
H03	Hierarchical navigation structure	The current operating systems all use this partly as it is easy for the user to understand. It is also stated in the brand guidelines.	Required	System research, visual elements design
H04	Provide feedback that an action has been registered (e.g. a click) or that something is loading	The user needs immediate feedback to understand that the system is working.	Required	Literature study, design guidelines
H05	All interaction with the application should be made directly on the screen	Conventional for smartphones for iOS, Android and Windows	Required	Design guidelines
H06	The number of clicks used to navigate through the system should be fewer than for similar functionality in the reference systems	The application is supposed to make the booking of meetings more efficient	Required	System research
	Priority 1			
H07	The user should be able to skip choices that he does not feel are relevant to his search	Reduce the number of clicks in the system and make the interaction more efficient	1	System research
H08	The number of possible paths to complete a task should be no more than two	Due to the limited functionality and depth of a smart phone application, the interface should be simple to navigate so that the user does not become confused if there are several ways to perform the same task.	1	Literature study, system research, user study
H09	Make previous choices and settings visible throughout a booking	The application should support the user's memory	1	Literature study, market research
H10	The use of the smartphone's keyboard should be minimized.	It is not beneficial to use the keyboard with one hand or when moving.	1	Literature study, market research
	Priority 2			
H12	Use picker wheels for time and date settings	Conventional for smartphones for iOS, Android and Windows	2	Design guidelines
H13	All selection should be made in a single screen before the results are loaded (may use flickering to the side for panoramic navigation).	This would enable quick and efficient navigation as well as better overview of choices made.	2	User study
	Priority 3			
H14	Use some navigation techniques from the previous interface	The user should know instinctively how to interact with the system	3	Design guidelines
	Priority 4			
H15	Encourage the user to unbook rooms that he does not intend to use	Make more rooms available. It should be easy to unbook but the user should be in control of it	4	User study

	Guidelines			
H17	Allow for quick and smooth navigation through the system	If the system provides clues on how to navigate, the user will learn more quickly and also be directed right from the beginning.	Medium	Literature study, system research, visual elements design
H18	The handling of the interface should remind the user of previous interfaces.	This will improve usability.	Low	Literature study, visual elements design
H19	The user should always be presented with a graceful way to cancel an action	This will make the user like the interface more as he is in control and the risk of error consequences become smaller	Medium	Literature study, visual elements design
H20	Minimize the number of screens that the user has to navigate through	The handling will appear more efficient and provide better overview if as many selections as possible are performed in the same screen.	Medium	User study
H21	Design the functionality around how the user would interact with it	This is part of Volvo Cars brand strategy "Designed Around You"	High	Visual elements design
H22	Actions should be simple and straight forward	The user should know instinctively how to interact with the system	Medium	Design guidelines
H23	Make use of the multi-touch system	This will make the interface more interesting and the multi-touch screen offers efficient ways of navigating through the system	High	Design guidelines
H24	Divide complex tasks into smaller steps	To avoid the user missing steps or becoming confused by information overload	High	Design guidelines
H25	Only interrupt the user if it is important	Can make the user frustrated when e.g. having to close pop-ups or confirm choices several times	High	Design guidelines
H26	Offer the most likely instead of several	Will make the user feel like the system is smart and efficient to use	Medium	Design guidelines
H27	Use common handling patterns in the interaction design	The user should know instinctively how to interact with the system	Medium	Design guidelines
H28	Avoid providing several paths and choices	Can result in an unstructured and confusing navigation	Medium	Design guidelines
H29	Offer opportunities for shortcuts	Will be popular for frequent and expert users	Medium	Design guidelines
H30	Provide a clear path of interaction	The user should know instinctively how to interact with the system	High	Design guidelines
H31	Design to make it hard to make mistakes	The user does not like to feel stupid or be afraid to try functions	High	Literature study, design guidelines
H32	Provide clues of what to do next	If the user doubts what to do next, the system should offer help	Medium	Design guidelines
H33	Make it easy to recover	The user should not be afraid to try new functionality and explore the interface	High	Literature study, design guidelines
H34	Do not make the user feel restricted	Even though there are not that many options for interaction, the user wants to feel like he controls the system and not the opposite	Medium	Design guidelines
H35	Reduce the number of possible mistakes	The user should not be afraid to try new functionality and explore the interface	High	Literature study, design guidelines
H36	Design the navigation for the user's mental model concerning navigation	The user should know instinctively how to interact with the system	Medium	Literature study
H37	Avoid strain on the user's short-term memory	It should be easy and efficient to use the system while multi-tasking as it is to be suitable for a smartphone	High	Literature study
H38	The user should know where he is in the navigation	Facilitate interaction and increase satisfaction	Medium	Design guidelines
H39	Have the brand statement "Designed Around You" in mind	Stated in the brand guidelines	High	Brand guidelines
H40	Minimize the number of clicks required to perform a task	The users want the interaction to be quick and easy - "like click click"	High	User study
H41	Use elements or navigation techniques from previous interfaces where appropriate	Facilitates learning and users like to be familiar with an interface quickly	Low	Literature study
H42	The interface should be user friendly for a target group between 25 and 55.	95% of the staff is within this age-range.	High	Goal formulation

ID	Requirements	Motivation	Priority	Origin
F01	Possible to sort between a large quantity of rooms	This is one of the reasons why PV prefers VROOM to Outlook. Should be easy to sort through a large quantity of rooms.	Required	User interviews
F02	Ability to filter search based on time, equipment and/or location	These are the most frequent variables that the user's base their searches on.	Required	User studies
F03	Synchronize the booking made with the user's calendar	Important to motivate the use of the application	Required	User study
F04	Booking a meeting should be the main function of the application	What initiated the project	Required	Project definition
F05	The following actions should be available: book a single meeting, show a resource schedule, show my reservations	These are the frequently used functions in the reference interfaces	Required	Project definition
F06	Insert booking into all participants schedules	Has to be practical and avoid having to perform a booking in more than one system	Required	System research, user study
F07	Possible to search for available rooms	This is the main purpose of the application.	Required	Project definition
F08	Suitable for HTML5 coding	Enable the use of the same code to be used in both iOS and Android. Many interviewees requested some way of finding rooms as the names not always express the location.	Required	Project definition
F09	Help the user locate a room	This is the main purpose of the application.	Required	Interview
F10	Possibility to see if a specific rooms is available or occupied	Important to sync calendar and contacts with the app to make it functional	Required	Project definition
F11	Integrate functionality with Outlook e-mail, schedules and contacts		Required	System research, user study
F12	The application should not apply Boolean logic that interferes with the user's intuitive logic.	Most regular users do not understand it	Required	ECM/PUEA
F14	Make sure that the user can never book an end time prior to the start time	Minimize opportunities for error	Required	System research, literature research
F15	The booker's building should be used as default setting for prioritization of rooms	Most common for the user to book rooms in the building where he is seated	Required	User study
F16	Make the default time of the meeting 30min	Expressed as good by the users	Required	User study
F17	Present the most likely choice of room for the meeting in a clear way	Most users are satisfied with being directed to a suitable room instead of choosing from a list	Required	User study
F18	Possible to see where the user's next appointments is	Desired by the users	Required	User study
Priority 1				
F19	The function of seeing one's next meeting should be available within 3 clicks.	It is expected that the functionality is used often.	1	Goal formulation
F20	Show an image or other form of representation of the room	Interviewees expressed a desire to see how the room looks with respect to types of furniture and windows to see if it is suitable for the meeting.	1	User study
F21	Not require logging in	This has created frustration with VROOM so it should be avoided	1	System research, user study
F22	Possible to invite other participants	Important in order to make the booking efficient.	1	System research, user study
F23	The user should be able to book a room at present time	Expressed as the shortest notice by the users	1	User study
F24	The user should be able to book a room up to a month in advance	Expressed as the earliest notice by the users (unless the meeting is reoccurring)	1	User study
F25	Possible to sort room by house, floor and division of a house	Easy to choose a room near the user in a large building	1	System research
F26	Possible to create and save meeting profiles	Make booking more efficient and increase system potential and experienced user performance	1	System research, user study
F27	Rooms currently available should be prioritized according to distance from the user's standard position	If there are no available rooms at the desired time, users often meet at the bookers desk and walk around and look	1	User study

	Priority 2			
F28	Find the user's current location and provide directions	Simplify finding one's way to a room	2	User study
F29	When the user searches for currently available rooms, rooms that are not bookable should be shown if they are available	Increase the usage of the rooms that have restricted booking access	2	Interview
F30	Possibility for the user to block or prioritize certain rooms based on individual preferences	Most users tend to book or avoid certain rooms based on non-factual properties	2	User study
F31	Predict the most likely place of the meeting. E.g. if 3 out of 5 participants are situated in the same building, the rooms in that building should be prioritized	Irritating if the system is not "smart"	2	User study, design guidelines
	Priority 3			
F32	Possible to compare room schedules	Get a better overview of the availability of rooms	3	User study
F33	A "splash-screen" showing progress should be used if the program needs updating before start-up	This will show the user that something is happening	3	Visual elements design
F34	Suggest alternatives to searches	If the user is flexible with e.g. time, alternatives should be provided if the search is not satisfying	3	User study, system research
	Priority 4			
F35	Ability to show which participants have accepted the invitation	Could be good to see if one should wait for participants that have not arrived yet. See if all required have accepted	4	User study
F36	Possible to see what the purpose of another user's booking in a specific room	Often that reoccurring bookings are not cancelled during e.g. vacations or that the booker is away. Certain bookings are still in the system even if the project has been put on hold.	4	User study
	Guidelines			
F37	The GUI should be adapted to the smallest screen and the highest resolution	To make sure that it can be used on all screens with good visual clarity	High	Hardware specifications
F38	Limit the number of functions to a maximum of 5 (one main function/purpose)	Otherwise the application might be confusing due to difficult navigation and no clear path	High	Design guidelines, literature study
F39	The system should be able to remember the user's preferences	Express during the user interviews	High	User study
F40	Avoid making the user wait for the system (e.g. when loading screens)	Waiting for loading screens and slow graphics can be highly annoying, especially if the app is supposed to make a current system more efficient	Medium	Design guidelines
F41	The system should be able to predict its status	It is very hard for a user to predict system status based on current data	Low	Literature study
F42	The system should enable the user to efficiently book a meeting	Stated in the project definition	High	Project definition
F43	The interface should be designed with the brand statement "Designed Around You" in mind.	Focus on what the user wants and make it the primary functionality	High	Brand guidelines

9. GRAPHICAL USER INTERFACE DEVELOPMENT GUIDELINES

1 SYSTEM INVESTIGATION

The methods described in this section are meant to be applied if the project involves making improvements on a current system, or basing the functionality of a new system on an old one. It is important to understand the current functionality so that the new interface can match all requirements from the old one if it is meant to be replaced.

1.1 HEURISTIC TASK ANALYSIS (HTA)

A Heuristic Task Analysis (HTA) is used to map the interaction with the system. It provides a basis for further evaluation and comparison. An HTA describes the interaction step by step and can describe a specific task or an entire system. If it is a complex interface, it is recommended to construct several HTAs to cover all relevant tasks and paths. Figure 1 is an example of an HTA, showing how the user books a room in the VROOM-system.

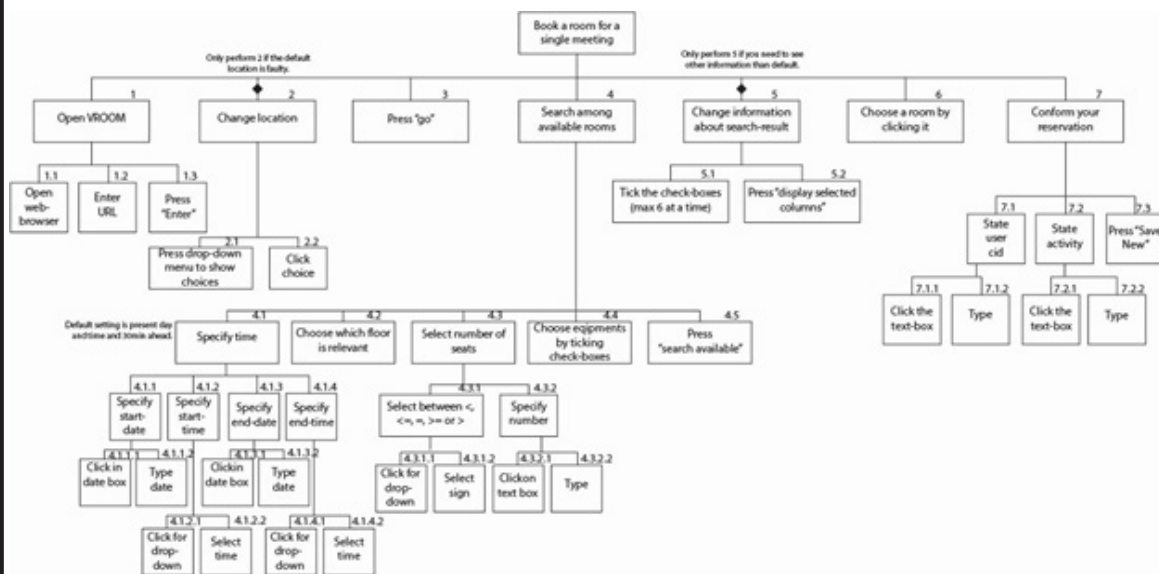


Figure 1. HTA example.

How to:

1. Define a task with a clear start and finish.
2. Name the task for the "0-level", Called "Book a room for a single meeting" in the figure.
3. Define the different sub-steps included. Tasks that are not required are marked with a comment and black rectangle above (see step 2 and 5 in figure 1). If there are two alternative paths that the user can perform, they are marked as in figure 2.
4. Define the different steps included in each sub-step. The number of levels required in the hierarchy depends on the complexity of the task and the purpose of the investigation. The part of an HTA in figure 1 is defined down to the task of clicking on specific buttons and typing.
5. Go through the HTA to make sure that each task is placed correctly and the interaction represents reality.
6. Number each step and sub-steps to facilitate future reference and discussion.

Figure 2. Alternative paths in a HTA.



Example requirements:

ID	Description	Motivation	Priority
1.1.1	The task should contain fewer steps in the concept than the reference interfaces.	Motivates the creation of the concept.	Requirement
1.1.2	The user should be able to skip steps that are not relevant to the search.	More efficient interaction and reduce the number of clicks.	Guideline
1.1.3	Divide complex tasks into smaller steps.	Prevents the user from missing steps or becoming confused by information overload.	Guideline
1.1.4	Avoid providing more than 1-2 paths for the same task.	Can result in an unstructured and confusing navigation.	Requirement
1.1.5	The functionality from the reference interfaces should be available in the concept.	The concept is meant to have the same functionality.	Requirement

1.2 ECW /PUEA

When conducting an Enhanced Cognitive Walkthrough (ECW), one can predict and identify potential usability problems in one's human-machine system. The analysis is made on two levels of the HTA. The 0-level is called the functional level and is processed by five questions. The 1-level is named the operational level and is processed by four questions. The lower levels are also evaluated using the operational level questions, but only as low as it is relevant (it is e.g. not interesting to evaluate a step in the HTA that describes how the user clicks a specific button). The results from each level are compiled in a template where the issues of success/fail story, potential usability problem, problem seriousness and problem type are commented.

The seriousness of the potential usability problem is graded on a 1-5 scale that represents the chance of successfully performing the task. The grading is shown in table 1 below.

Grade	Grade in words	Explanation
1	No	A very small chance of success.
2	No, uncertain	Small chance of success.
3	Do not know	Impossible to decide if success or not.
4	Yes, probably	Probably successful.
5	Yes	A very good chance of success.

Table 1. Problem seriousness grading for ECW.

The usability problems are also classified depending on the origin of the problem. The different categories used for classification are shown in the table below.

Problem Type	Explication
User (U)	The problem is due to the operator's experience and knowledge.
Hidden (H)	The interface gives no indications that the function is available or how it should be used.
Text and icon (T)	Placement, appearance and content can easily be misinterpreted or not understood.
Sequence (S)	Functions and operations have to be performed in an unnatural sequence.
Feedback (F)	The interface gives unclear indications of what the operator is doing or has done.

Table 2. Usability problem origin definitions.

A Predictive Use Error Analysis (PUEA) is used to predict and identify potential use errors, similarly to an ECW. Questions are posed on both the functional and operational level of the HTA and a grading of the seriousness and classification of the error type and cause are done.

- Error types: The potential errors are classified into six categories; plan, action, checking, retrieval, communication and selection and each category contains several different types (see appendix).
- Error causes: The causes of the use error is divided into five categories; lapse, slip, rule-based mistake, knowledge-based mistake and violation based on which level of decision making that the user operates on.
- Consequence seriousness: The seriousness of the consequence of a potential error is graded on a 5-point scale where the explanations for each value are adjusted to the interface being evaluated. The value also depends on the severity of the secondary consequence that may arise.
- Error Detection: The 5-point scale shows how likely the user is to detect the error before the secondary consequence occur.

Grade	Grade in words	Explanation
1	Improbable	Extremely difficult to detect.
2	Remote	Difficult to detect.
3	Occasional	May be detected.
4	Reasonable	Likely to be detected.
5	Frequent	Most often or always detected.

An example of an ECW/PUEA from the project is shown in figure 3. Form for using the methods can be found in the appendix.

ECW				
VROOM - (book a room for a single meeting + book a projector) Search for available resources	Task 4.2: Choose which floor is relevant by clicking checkboxes			User, Hidden, Text and icon, Sequence, Feedback
	Success/Fail story	Potential Usability problem	Problem seriousness (1-5)	Problem type (U, H, T, S, F)
1. Will the user try to achieve the right effect?	Yes	No problem	5	-
2. Will the user be able to notice that the correct action is available?	Yes	No problem	5	-
3. Will the user associate the correct action with the desired effect?	Partly	The user might click two or more floors as several are possible, this will result in no rooms found as VROOM works with Boolean logic.	3	User, Hidden, Feedback
4. Will the user get sufficient feedback to understand that the desired handling has been performed correctly?	No	There is no warning that one should not choose more than one floor	3	Hidden, Feedback
PUEA				
Use Error	Error Type	Error Cause	Primary consequence	Secondary consequence (1-5)
Description of error	Which type of use error?	Why does the use error occur?	What is the direct effect of the user error?	What is the secondary consequence?
The user tries to select two floors (or more) as both are suitable for the meeting. But the search generates no results.	A4 - Action too much	Knowledge-based mistake: the user is not aware of the implications of Boolean logic	The search will not generate any results	2 - the user will not find any rooms available for a meeting
Error detection (1-5)	Error recovery	Consequence protection	Error prevention	
Can the user detect a use error before any secondary consequences occur?	Can the user recover from the use error before any severe consequences occur?	Measures to protect from the secondary consequences.	Measures to prevent occurrence of use error.	
1 - the user will not know the error unless familiar with Boolean logic	The user can uncheck the boxes if aware of the problem.	None	None	

Figure 3. Example ECW/PUEA.

Example requirements:

ID	Description	Motivation	Priority
1.2.1	Reduce the number of possible mistakes (at least less than in the reference interfaces).	The user should not be afraid of trying new functionality.	Requirement
1.2.2	The application should not apply Boolean logic in a way that is counter intuitive and conflicts with the user's mental model.	Most users do not understand it and it limits the search too much.	Requirement
1.2.3	Make it possible to cancel and action on several occasions in the interaction.	Limit the risk of any primary or secondary consequences occurring.	Requirement
1.2.4	Design so that irreversible actions require confirmation, such as deleting a meeting.	Prevent irreversible mistakes.	Requirement
1.2.5	Provide a clear path of interaction.	Make it easier for the user to interact with the interface.	Guideline

1.3 EFFICIENCY EVALUATION

The efficiency of the current system can be measured by e.g. how many clicks or how long time it takes to perform a task. The results are then used for comparison with the new interface at the end of the project. Use the previously constructed HTAs to help keep track on the interaction when counting.

If the time required to perform a task is measure, the evaluation should be suitable for comparison with the concept. One should therefore try to use inexperienced users of the reference systems as any previous use of the system will make the interaction faster. The users of the concept interface will always be inexperienced.

The results should be presented in tables to allow for easy overview. The example in table 3 is based on several HTAs. As there were several actions that did not have to be performed, a maximum and minimum amount of clicks was counted in addition to the most probable that assumed that all default settings were correct (based on user interviews).

Number of clicks (Max/Min/Prob)	Book a room	Show my reservations	Show a specific room's schedule	Book a projector	Book a conference phone
Microsoft Outlook	20/10/15 (1) 23/12/15 (2)	4/3/3	8/8/8	NA	NA
VROOM	53/9/36	4/4/4	12/6/6	38/12/19	36/12/19

Table 3. Table of results from efficiency evaluation

In the efficiency evaluation in the example, booking a room in Outlook was performed in two separate ways. The result marked with (1) is when the user chooses a suggested room provided by the program and (2) is when the scheduling assistant is used. The overall results show that Outlook is more efficient than VROOM, but it is important to note that VROOM allows the user to filter searches by e.g. equipment, which is why the maximum number of clicks is so high.

How to:

1. Define the task so that it possible to make future comparisons (e.g. will the evaluation include the start-up of the program that the task is performed in?)
2. Go through the task, possibly with the help of the HTA and count the number of clicks or use of keyboard. If performed during a user interview, one can measure how long time it takes to complete the task, but make sure that the interviewee is aware of the measurement.
3. Summarise the results in an understandable way in a table.

Example requirements:

ID	Description	Motivation	Priority
1.3.1	The number of clicks required to perform a task should be fewer than in the reference interfaces.	The concept should be more efficient that the references.	Requirement
1.3.2	The maximum amount of clicks should not be more than 100% greater than the minimum amount.	Decrease the number of unnecessary clicks.	Guideline

1.4 USABILITY ANALYSIS

A usability analysis evaluates how easy the system is to use in terms of Guessability, Learnability, Experienced User Performance, System potential and Re-usability. The results are described in text and possibly on a scale from 1(poor) to 10(excellent). The evaluation is performed by the developer/analyst – not interviewees (but their opinions can be taken into consideration).

- Guessability – How easy is it for a first time user to utilise the system? Number of mistakes and time are taken into consideration.
- Learnability – How easy is it to learn the system? Are the interaction patterns similar for different tasks?
- Experienced User Performance – Can an experienced user handle the interface in a highly efficient way through e.g. shortcuts or personalisation?
- System potential – What is the least amount of steps required to perform a task? Does the system have the potential to be highly efficient or is the interaction pattern fixed?
- Re-usability – How easy is it to use the system after a longer absence? How much effort is required to remember the functionality and interaction patterns?

How to:

4. Make sure you have an understanding of the system(s) you want to evaluate.
5. Go through each topic separately and document the discussion.
6. (Optional) Grade the level of each topic on a scale from 1 (poor) to 10 (excellent).

Keep in mind that the discussion is the most desired result, the grading is mostly meant for future reference and comparison. Results from the project can be found in the appendix. The requirements extracted from a usability analysis are often quite general and describe interface design guidelines that can be applied to most interfaces.

Example requirements:

ID	Description	Motivation	Priority
1.4.1	Provide clues on what to do next in the interaction.	Increase guessability and learnability.	Requirement
1.4.2	Provide shortcuts for commonly performed tasks.	Increase experienced user performance	Requirement
1.4.3	Minimise the time and effort to perform a task in the interface.	Increase system potential	Guideline
1.4.4	The interface should remind the user of the appearance and handling of similar interfaces.	Allow for guessability, learnability and good re-usability	Guideline

2 USER STUDY

The methods described in this section are meant to aid in the study of the users of the current system, or the users of the future system. They are meant to complement and confirm results from the investigation phase, as well as starting to define the users' requirements and desires on a future system.

This phase should be performed in depth to consider the brand statement "Designed Around You @ Work".

2.1 INTERVIEWS

Performing interviews with current and future users is the most important activity in this phase. It is recommended to have certain questions defined beforehand, but let the interviewee speak freely to open up for a discussion. If there is a reference system, it can be beneficial to ask the user to think out loud when performing important tasks. Interviewing several people at once in a focus group can also be useful to encourage discussions, but then, only topics and general questions should be used.

Remember:

- Use a sound recorded (screen recording as well if "think out loud"-method is used). It is difficult to take notes or remember everything that is said.
- Do not be afraid to stray from the questions – a semi-structured interview is often preferred.
- Encourage creative discussions, especially in focus groups.

How to:

7. Consider what it is you want to get out of the interviews and how long time they are allowed to take.
8. Start by formulating questions that concern how the user wants to work and what he imagines that the interface can do for him. Do not focus on the current interfaces in the beginning as this might limit the user's imagination.
9. Then go into the problems that the user experiences today and why they occur.
10. Ask the user to perform some tasks in the current interface while speaking out loud what he is thinking. This will encourage the discussion about the problems of the system, but be sure to ask about the benefits as well.
11. Organise the questions so that you start with specific ones such as name, work title etc. to make the interviewee comfortable. Then go into more abstract and large questions. Finish with one or two more specific questions to wrap up the interview.
12. It can be a good idea to write down some comments that might aid the user's imagination if some questions become too large or vague. But be sure not to impose your own ideas on them.

Examples of questions:

- What do you like and dislike about your daily work?
- How do you imagine that the application will aid you in the future?
- What functionality would you expect from this type of application?
- What do you find positive and negative with the current interface?
- Why does the current interface not satisfy your demands?

(More examples from the project can be found in the appendix.)

Example requirements:

ID	Description	Motivation	Priority
2.1.1	Certain aspects of the interaction should be similar to the reference interfaces.	Some similarities to the reference interfaces will make the user feel more familiar with the system and learn more quickly.	Guideline
2.1.2	Show who has accepted a meeting invitation in a good overview.	In that way, the user will know whether or not to wait for additional participants.	Requirement
2.1.3	Finding rooms that are available right now should be a main function.	Frequently occurs that you meet up and walk around looking for a room.	Requirement
2.1.4	Provide location of the room on a map or directions to it.	Many have problems finding rooms, especially when located in an unfamiliar building.	Requirement
2.1.5	The application should provide alternatives to your search if no available rooms are found based on your filters.	Few rooms are available at the time you want them to be. Most users are flexible with time and place of the meeting.	Requirement

2.2 QUANTITATIVE EVALUATION

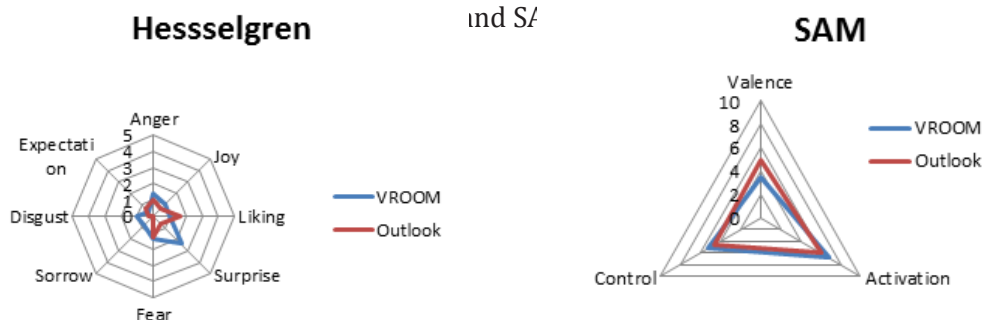
Several methods can be used to evaluate the user's responses to the current system. It can be good to use at least one if you want to have numeric results for future concept evaluations.

The methods are preferably performed during an interview where the user is asked to use the system right before – preferably only a few minutes prior – as this will increase the validity of the results.

The results of two methods are found below:

- Hesselgren measures the emotional response to the appearance and interaction with the interface. This is relevant as emotions are highly affected by visual stimuli.
- Self-Assessment Manikin (SAM) concerns the user's mental effort when interacting with the system. The method can be used for separate tasks or the entire system, depending on the purpose of the evaluation.

Results from the evaluation of the reference interfaces in the project can be found below.



Example requirements:

ID	Description	Motivation	Priority
2.2.1	The concept should have a lower level of activation than the reference interfaces.	The application should not have to demand the user's full attention as the distractions can be many.	Requirement
2.2.2	The concept should have a low level of anger and fear.	Less irritation is beneficial, as well as the user feeling comfortable and secure while using the application.	Requirement
2.2.3	The user should have a higher level of control than the reference interfaces.	The application should make the user feel more in control in order to encourage usage.	Requirement

2.3 Use case

A use case is formulated to understand the context in which the current system is used and which stakeholders are involved in the interaction (primary users, secondary users, side users, etc.). The use case should not specify any interaction with the system (e.g. "the user presses the button 'go'"). Forms for constructing a use case can be found in DITS.

In usability context, a use case aid in the understanding of the interaction with the system and who is affected by it. It can map the interaction so one can understand why certain functions should be prioritised and in which order actions in the system are performed. It can also help identify the needs of secondary users. In the case of the room finder application, an example of this is e.g. the booker of a room needs to be able to invite others to that meeting so the information has to be made available to them after the primary user has performed the booking.

Example requirements:


































































ID	Description	Motivation	Priority
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2.3.1	The user should be able to invite others to the meeting.	The persons participating in the meeting are the most important factor.	Requirement
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2.3.2	The user should be able to see the meetings up to at least a week in advance. The use should be able to manage his time and be able to plan for the upcoming meetings.		Requirement
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2.3.3	Enable the user to quickly search through available rooms and resources (functionality should be available within 5 sec).	The application should make the user's handling of meetings more efficient.	Requirement
-------	---	---	-------------

10. ICON EVALUATION

Projector	     
CAD-computer	   
TV	 
Phone	     
Conf. phone	   
Video conf.	   
White board	  
Computer screen	    
Flip chart	   
Docu. Camera	     
Overhead	  
PC	  
Work station	   
Number of places	   
Directions	      

11. FINAL CONCEPT EVALUATION INTERVIEW QUESTIONS

What is your first impression of the overview of the application?

What type of functionality do you think is available under the different headlines on the start screen?

My Calendar:

1. Do you think that it is beneficial to mark which meeting is booked by the user and which he is just invited to?
2. Which information do you think is important to know about the meeting?
3. How many meetings in advance do you consider useful to be able to see?

Book meeting:

1. What do you think about the filters used?
2. What do you think about the amount of information shown about the rooms in the search results?

Presets:

1. Do you think that this is a functionality that is useful for you?
2. Can you describe how you would do to use, change or delete a preset in this interface?

Rooms:

1. Do you imagine that you would use this functionality?
2. Do you find it easy to see which rooms are available?
3. Do you find the different views available through the tabs useful?

What do you think about the colours/absence of colours in the interface?

How would you describe the visual aspects of the interface (3 words).

12. CONCEPT APPLICATION DESCRIPTION



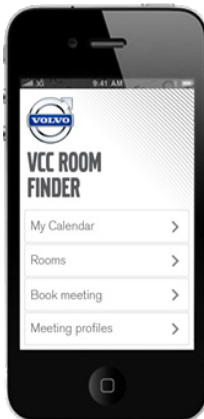
APPLICATION DESCRIPTION

This document is formulated to give a complete description of the functionality available in the concept application and how it is supposed to work. Each function is presented in order to illustrate a logical path of interaction. Different variations of each screen are demonstrated as so exemplify the underlying functionality and the different contexts in which the application is used.



SPLASH SCREEN

The first screen presented to the user when the application is opened is the splash screen, which is needed during the time it takes for the application to become synced with the Outlook system concerning calendars and contacts.

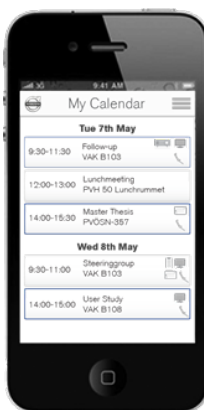


START SCREEN

The start screen opens when the splash screen is no longer needed and presents the user with four different choices. The user clicks on the desired functionality in order to jump into the interaction. When a button is tapped, it reacts by momentarily changing colour to the dark blue specified in the design guidelines.

MY CALENDAR

The calendar function presents the user's closest meetings.



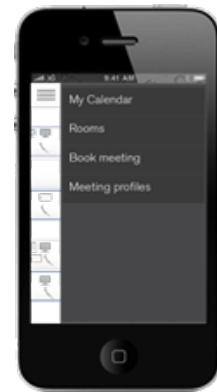
START VIEW

The most important information concerning the meeting is shown directly in the overview. This is information concerning time, subject, location and room-equipment. The blue stroke around a meeting indicates that this is a meeting that the user has booked, the ones with a light grey stroke are meetings that the user is invited to by someone else. The meetings are grouped by day of the week by showing weekday, date and month.

The Volvo mark is visible in the top left of the screen but is not interactive. To the right is a menu-icon that reveals a list menu which slides in from the right of the screen as is seen in the image below.

SIDE MENU

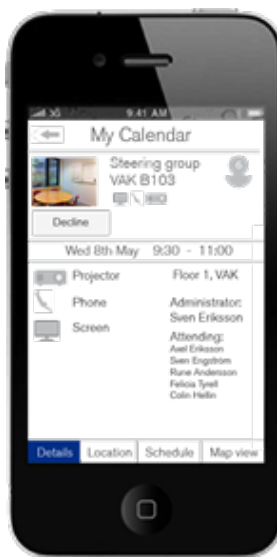
When the menu-icon is clicked, a side menu is revealed which presents the same choices as in the start view. The user can choose to click on any heading to change to a different function, or go back to the current function by either clicking the menu-icon again (which is now visible in the top left corner) or flick to the right.



DETAILED MEETING VIEW - INVITED

If the user clicks on a meeting without a blue stroke, he/she is directed to a view that displays the details concerning that particular meeting. A tab-menu indicates that more information can be revealed by either clicking on a different tab or flicking to the side. The activated tab is marked with the dark blue to separate it from the others.

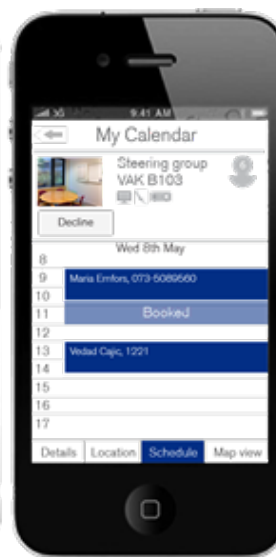
At the top of each screen is a backwards button in the left corner next to the heading of the function. This is used to show that the user is now on a deeper level of the hierarchy. The top of the view remains the same as the information shown there is prioritised and described as most important by the users. It shows an image of the room (which can be clicked for an enhanced view), the subject, room name, equipment in the room and number of seats available. There is also a button with which the user can choose to decline the meeting, thereby removing it from the calendar. If the meeting is declined, the user is directed back to the start view of the calendar function.



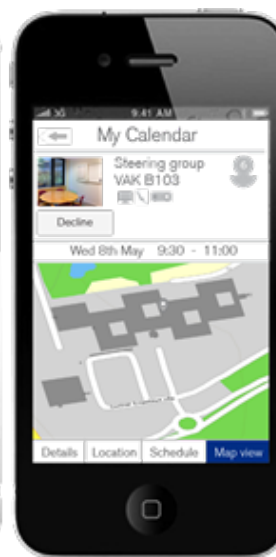
1



2



3



4

1 "Details": In the first tab, the user can see the time of the meeting, the equipment available in the room, written details of the room's location, who is the room administrator and who else has agreed to participate in the meeting.

2 "Location": In the second tab, a floor map of the building is shown and the room is marked in blue. Which floor the map shows is also shown. The user can zoom in the image to see further details.

3 "Schedule": The third tab shows the room's schedule during the day. Who has booked the meeting during the rest of the day is also shown, together with a contact number to those people in case the room is empty when it should be occupied. The meeting's booked time is

marked in a lighter blue but it is not possible to change it as the user is not the booker of the meeting.

4 “Map view”: The final tab shows a map of the area where the room is. The room’s location in the building is marked but the floor or any way of getting there is not displayed. The user can zoom in this view as well. This is mainly for the user to be able to see in which part of the building the room is and how to get there from the outside.



DECLINE POP-UP

If the user does not want to participate in the meeting anymore and clicks on the “Decline”-button available, a pop-up is shown which indicates that the action needs to be confirmed before it is executed. The “Yes” option is marked as it confirms the action. If it is clicked, the user is directed back to the main view for My Calendar as the booking is not present in the schedule anymore. If “No” is clicked, the pop-up simply disappears and the user can continue to see the details of the meeting.

DETAILED MEETING VIEW – BOOKER

If the user clicks on a meeting with a blue stroke, i.e. booked by him/her, a similar view describing the details of the meeting is shown. The only difference is that there are two buttons in the top section. The first one gives the user the option of cancelling the meeting, which will delete the meeting in all participating calendars. The other button offers the choice of rescheduling the meeting. If it is clicked, the user is directed to the “Book meeting” function where the filters have already been added – this enables the user to simply search for a new time using the settings as for the meeting that is to be rescheduled.



CANCEL POP-UP

If the user wants to cancel a meeting and clicks on the “Cancel”-button available, a pop-up is shown which indicates that the action needs to be confirmed before it is executed. The “Yes” option is marked as it confirms the action. If it is clicked, the user is directed back to the main view for My Calendar as the booking is not present in the schedule anymore. If “No” is clicked, the pop-up simply disappears and the user can continue to see the details of the meeting.

BOOK MEETING

Booking a meeting is the main function of the application. The benefits of being able to filter results based on time and preferences should be combined with the syncing with Outlook's calendar and contacts.

START VIEW

The image shows an extended view of how it can look when the user has chosen some filters for a search.

The user can first insert a subject for the meeting by clicking in the box which activates the phone's keyboard. Next to the box is the option of choosing to use a meeting profile which speeds up the search as the user might have saved common searches as profiles. If the user clicks on the icon, he/she is directed to the Meeting Profiles function where the options can be viewed, changed or used.

Below is the option of inviting other participants to the meeting. When the user clicks in the empty box, he/she is directed to the default calendar of the smartphone and can choose to add contacts from there. If the user invites the wrong person, the contact can easily be removed by clicking the "-" next to each name. There are two choices for finding the next available time; the button "Next available" means that the program itself scans through the participants schedule's to find the next time that all participants can meet. The wheel-picker below then spins forward to the next available time to show that something is happening in the application. The user can also choose to change the wheel-picker by hand if the time of the meeting is the most important factor.

Then is the option of choosing the location for the meeting. The user's stationary position is used as default. When a building name is clicked, it is marked in blue and more options concerning either body or floor are revealed. The user can choose to only select a building if floor or body does not matter. Several options can also be marked, e.g. if the user wants a room on either 1st or 2nd floor, both can be marked. More options of buildings are revealed if the line below is clicked. The arrow then changes direction indicating that the view can be minimised again. If the user has invited a majority of participants from one building, that one is automatically chosen by the interface to minimise the need for travel.

Another wheel-picker enables the user to choose the minimum amount of seats available in the room. The number shown initially is adapted to the number of people invited above.

A choice of equipment required is the final filtering option. The five most common are shown above the line indicating that more options can be revealed – these are flip-chart, white-board, projector, conference phone and screen.

When the user is satisfied with the filters, "Search" is clicked. Next to the button is an icon indicating that the filters can be saved as a meeting profile if the user expects that they are to be used more in the future.

SCHEDULE COMPARISON

When "Schedules" below the invited participants is clicked, the user is shown the relevant schedules in a way that enables comparison. He/she is able to add or remove participants in this view as well. A bar marks the relevant time. It can be expanded by dragging in each end. At the bottom is a button that says "Choose", if clicked, the user is directed

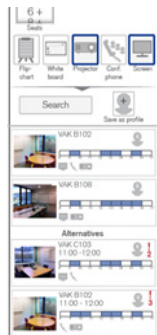


back to the booking-menu with the time marked shown by the wheel-picker. The “Cancel”-button in the top-right corner takes the user back to the booking-menu without a time being chosen.



SAVE MEETING PROFILE POP-UP

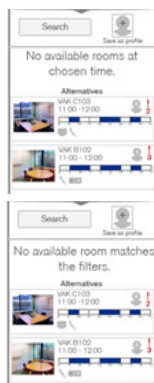
If the user wants to save the filters as a meeting profile by clicking on the option next to “Search”. The user can choose to click “Save” directly, which will save the profile as “profile 1”, or click in the box and type a name. The user is directed back to the booking menu when either Save or Cancel is clicked.



ROOM OPTIONS

The options of available rooms are shown below the filters. The user can choose to change the filters and redo the search if he/she wants to. The options are shown in a list with the most important information visible; the room’s name, number of seats, equipment and a bar that shows the room’s availability during the day.

Below the alternatives that match the search are alternatives in case the user does not like any of the above. The number of deviations from the search is shown with a red exclamation mark and shown further in the detailed view.



NO ROOMS AVAILABLE

If no rooms are available that match the user’s choice of filters or time, a message is shown indicating this along with alternatives to the search.

ROOM DETAILS

When the user clicks and chooses a room from the list of available options (that match the search filters) details of the room are shown with a tab-menu indicating that more information is available. The views are the same as in the calendar function except for minor details. A “Book”-button is always available in the top section.



ROOM DETAILS – CONFLICT

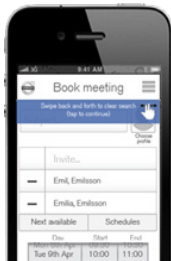
If a room is chosen that has one or more conflicts concerning the selected filters. The conflicts are marked in red and can have to do with number of seats, time, lack of equipment or participants that have a conflict in their schedule. If the user considers these conflicts to be acceptable, the rooms can be booked anyway.





BOOKING CONFIRMATION

Once a room is booked, with or without conflicts, the user is directed to the calendar function. In this view, a blue section in the top of the screen says that a certain booking has been added to the calendar so that the user receives visual confirmation that the action has been performed. The blue section disappears as soon as the user taps anywhere on the screen and can then be found in the calendar in its correct place.



BOOK MEETING – WITH CLUE

The first time the application is opened, a clue is displayed in the book meeting view that describes the action of cleaning the filters so that a search can be done from the beginning.

The user can swipe two fingers across the screen three times, so as to simulate an erasing motion, and all previous selections will be cleared.



MEETING PROFILES

Frequent searches can be saved as meeting profiles in order to speed up future searches.



START VIEW

When the user opens the function, the saved profiles are shown at the top (up to 5 can be saved at a time) and the option of creating a new below.

The user can then choose to edit, use or delete an existing meeting profile. When deleting or overwriting an existing profile, the user needs to confirm the action through a pop-up. When saving a new one, the same pop-up as in the Book meeting-function is shown which offers the user the possibility to save the profile. If "Use" is clicked, the user is directed to the Book meeting function where the filters from the profile have been added.

The choices of filters functions in the same way as in the book meeting function, except that the option of adding a subject and selecting time is removed.

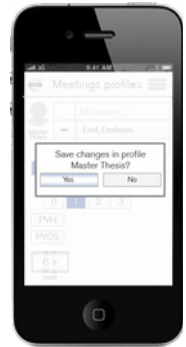
At the bottom is the choice of creating a new meeting profile. Below the selections are only one button that says "Save". When the user has made all selections and clicked "Save", the same pop-up as when saving a search in Book meeting is shown, enabling the user to name the profile.

EDIT VIEW

When "Edit" is clicked, the view changes so that the user can change settings of a meeting profile. The previous selections are marked and the "Edit"-button at the bottom changes to "Save".

OVERWRITE POP-UP

The user needs to confirm the action of saving changes to a profile before they are made as this is an irreversible action.



DELETE POP-UP

The user also needs to confirm the action of deleting a meeting profile as this is an irreversible action.



ROOMS

This function contains information of rooms available right now and their location, as well the option to search for a specific room.

START VIEW

When the user opens the function, the rooms available right now are shown first, but a tab-menu shows that more options are available. The user can also choose to change the building in which to look for rooms by scrolling in the field at the bottom where the building's names are shown. The most important information about the rooms are shown in the initial list view; until which time the room is available, the name of it, it's availability during the day and the number of seats. Each field is clickable which enables the user to book the room.



BOOK FROM "AVAILABLE"

If a field in the Available tab is clicked, a pop-up appears that enables the user to book the room. The equipment available in the rooms is shown together with its name and number of seats.

A ticker wheel allows the user to choose until when to book the room. It cannot go further than the room is available.



NO ROOMS AVAILABLE

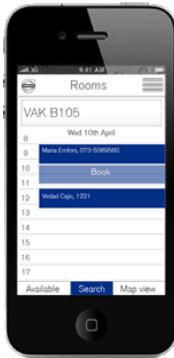
If no rooms are available in the chosen building, a message is shown indicating this together with a suggestion to choose another building.





AVAILABLE – WITH CLUES

The first time the application is opened and the function used, clues help the user to quickly understand the possible ways of interacting with the application. The clues describe how the user can refresh the page and change building using the bar at the bottom. The clues disappear as soon as the screen is tapped.



SEARCH VIEW

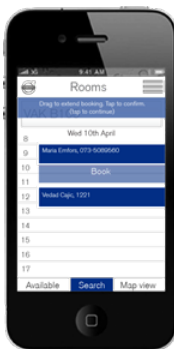
The second tab allows the user to search for a specific room. The user taps in the box and writes the name of the room. The schedule is then shown below with today's date at the top.

Who has booked the room is shown together with phone numbers. The user can drag in the light blue area to extend the booking. When the area is then tapped, a pop-up appears to confirm the booking.



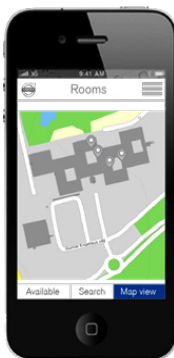
BOOK FROM "SEARCH"

The time is booked and the user is directed to the calendar view where confirmation is provided that the booking has been added to the calendar.



SEARCH - WITH CLUES

The first time the application is opened and the search function used, a clue describes how to manipulate the light blue marking in the schedule. It disappears as soon as the screen is tapped.



MAP VIEW

If the map-tab is selected, the user can see all the available rooms marked in the building. It is possible to zoom in and click on an icon to book the room. The user can also zoom out to see available rooms in other buildings.

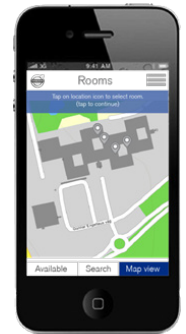
BOOK FROM "MAP VIEW"

When an icon on the map is clicked, the user can choose to book the room for as long time as it is available.

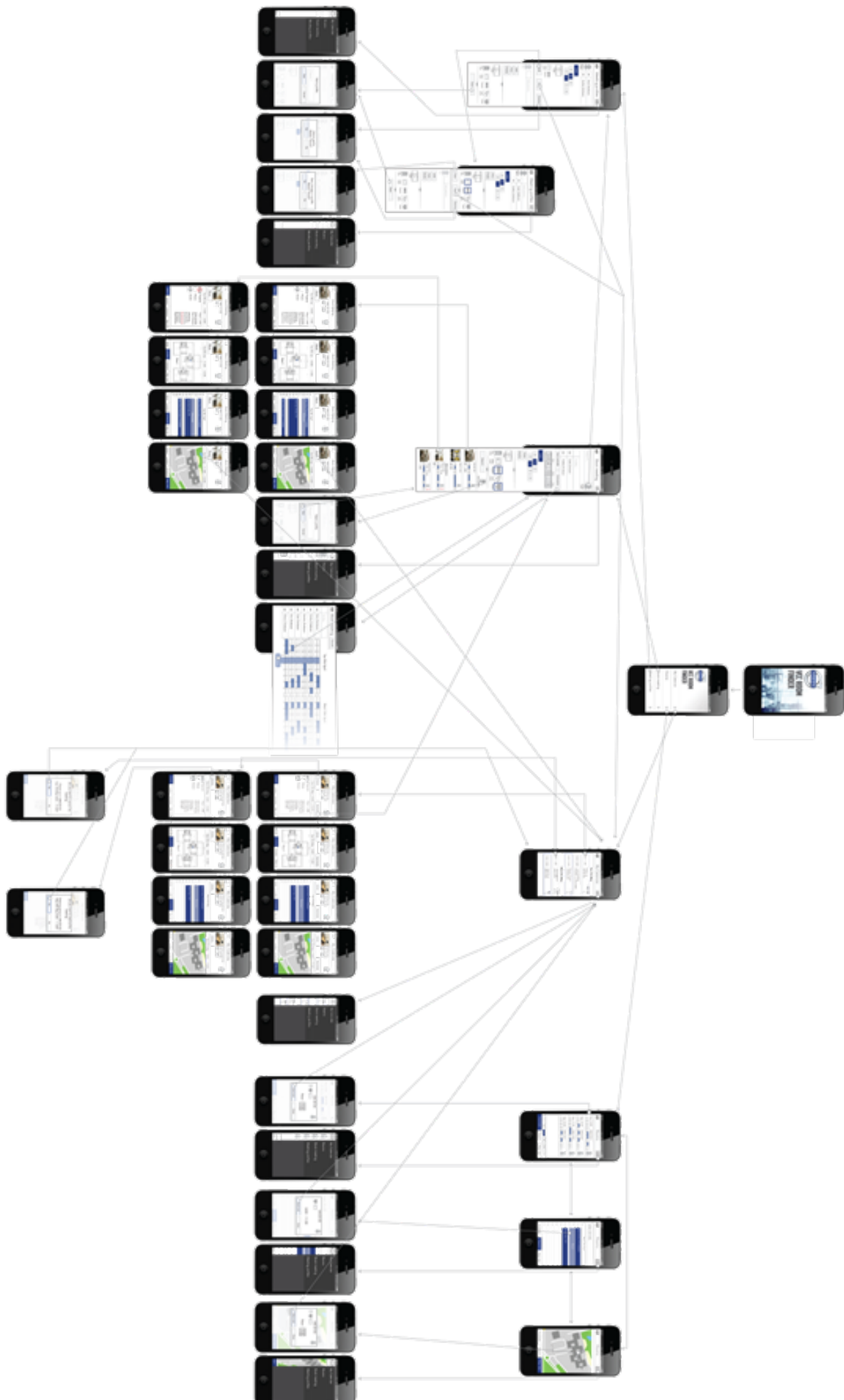


MAP VIEW – WITH CLUES

The clue in the map view simply describes the option of clicking on an icon to be able to book that room.



13. APPLICATION NAVIGATION OVERVIEW





GRAPHICAL USER INTERFACE

Design guidelines for smartphones

Issuer: [Name] [COS-ID] [Organisation] [Name of document] Security Class: [Proprietary] Date Created: [YYYY-MM-DD] 1

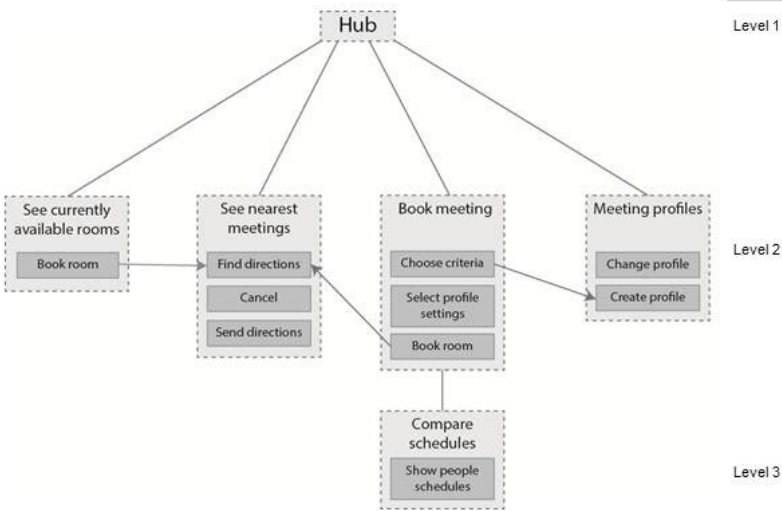
NAVIGATION



A hierarchical navigation is recommended for all Volvo Cars' digital communications.

This is a common way for smartphone users to handle applications. Certain deviations are allowed within each functionality if it contributes to a better flow of interaction or great level of innovation.

Applications should be no deeper than a level 4 hierarchy so as to be appropriate for both iOS and Android users.



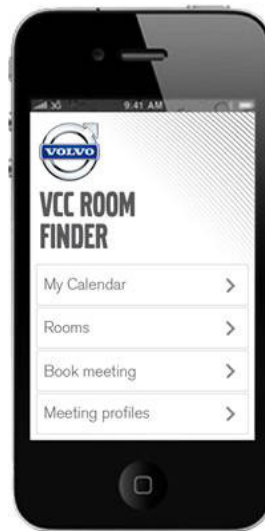
Issuer: [Name] [COS-ID] [Organisation] [Name of document] Security Class: [Proprietary] Date Created: [YYYY-MM-DD] 2

THE IRON MARK

The Iron mark does not have to be visible at all times in the interface. When it is used, it should be placed in the top left corner.

No alterations should be made to it, and any background should be uniform and complementary to its appearance.

The iron mark can be either 40px*40px or 16px*16px in size.



44*44px logo



16*16px logo



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Date Created: [YYYY-MM-DD]

3

COLOURS

The colours are meant to contribute to a professional expression.

The main colours used are shades of grey that blend well together and are suitable for a clean, confident and simple expression.

The accent colours are to be used in moderation so that they do not dominate the screen.

- ☐ 100% white. Used for text on coloured background.
- ☒ #3a3a3a – Darkest grey. Used for regular text and headings as well as text-background in side-menu.
- ☐ #b5b5b5 – Grey. Used for non-prioritized text. Main colour of icons. Button stroke colour.
- ☒ #4466aa – Blue. May be used for text outside buttons to indicate selection.
- ☐ #f4f4f4 – Light grey. Used for buttons.
- ☒ #be1e2d – Red. Used in extreme moderation to indicate warnings or conflicts.
- ☐ #808285 – Dark grey. Used for icons (mainly figure strokes).
- ☒ #022e85 – Dark blue. Used to indicate selections or feedback on pressed buttons.
- ☒ #474648 – Very dark grey. Used as background for the side-menu



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Date Created: [YYYY-MM-DD]

4

ICONS

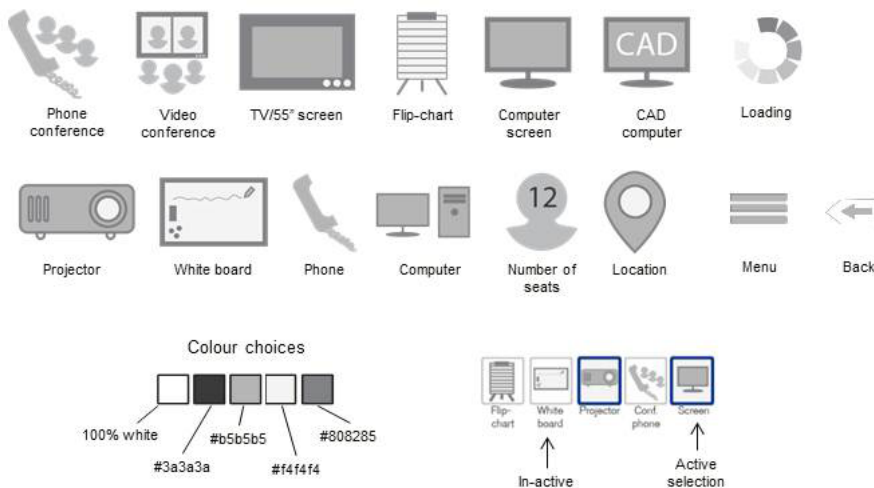


Icons in Volvo Cars' applications should be minimalistic and flat in their design.

Tones of grey should be used for their design and they should be obvious representations of reality.

When used in the interface, non-clickable icons should be at least 7px*7px in size. Clickable icons should be at least 25px*25px.

A clickable icon should have a frame to indicate this. The distinction between objects available for interaction should be shown in the same way. A clear difference should be made between static objects and elements available for interaction.



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Date Created: [YYYY-MM-DD]

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BUTTONS



The buttons should be square and clean in their design.

The boxes should be square with 1px corner radius. Buttons for main navigation or choices should be at least 44px*44px.

The bottom example shows how a button changes when clicked. This colour is derived from the iron mark and is used to mark selections, current tab-menu or give feedback that a button has been clicked.



Fill colour: #f4f4f4
Text colour: #3a3a3a
Font: Volvo Sans Light

Fill colour: #f4f4f4
Stroke colour: 1px #b5b5b5
Text colour: #3a3a3a
Font: Volvo Sans Light

Fill colour: #022E85
Text colour: #ffffff
Font: Volvo Sans Light

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Date Created: [YYYY-MM-DD]

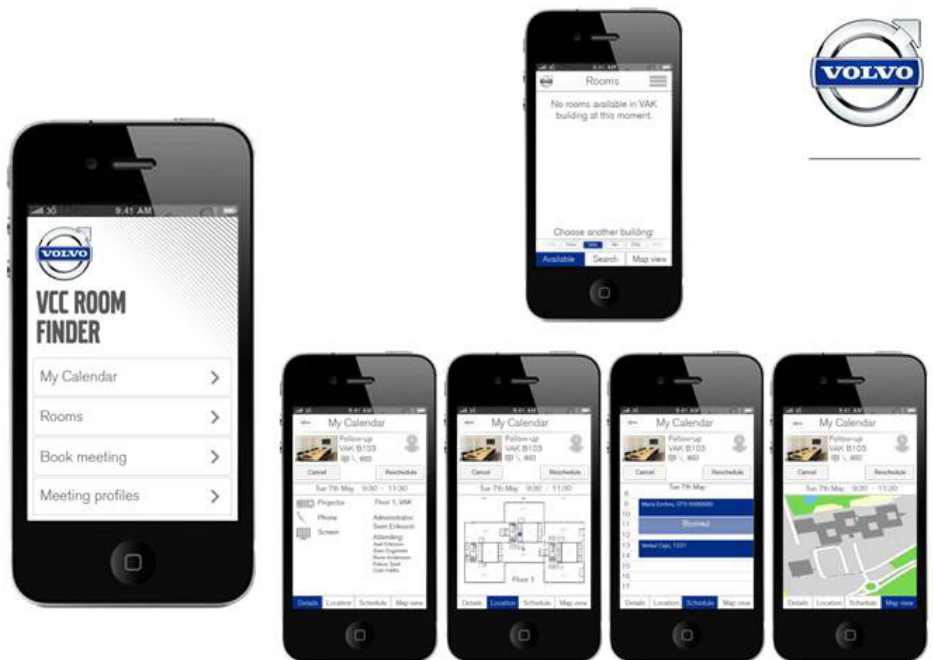
8

MENUES

List menu – the main navigation

Tab-menu – secondary navigation

Carousel – used in moderation for showing options according to categories.



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9

MENUES

List menu:

A list menu is easy to scan through thereby giving the user an overview of the choices. This is appropriate for the start screen as the choices are the main focus of the screen.



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10

MENUES



Tab-menu:

This type of menu has the benefit of displaying information in connection to the choices. This is suitable when several views are available on the same subject/object. At least 3 tabs should be present so that a distinction between the active and inactive tab is evident. No more than 5 tabs should be used to avoid cluttering.

The tab-menu is placed at the bottom of the screen so that the user will not block the content when clicking a tab. This also makes them easier to reach with a one-handed grip.



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MENUES



Carousel

The carousel is a different way of filtering choices and it is not commonly used in applications. The carousel is mainly used to show different images, but the interaction was considered suitable as it is a fast way to choose between many different options. It also prevents an extensive use of buttons as non-relevant choices are hidden until the user needs them.

If more than 15 items are needed in the carousel, another type of navigation might have to be considered as it can be hard for the user to get an overview of the choices. The objects in the carousel should be of a size that allows between 3-6 to be shown simultaneously.



In this view, the user is provided with feedback as to why no room can be found. A suggestion is made to choose another building in connection to the carousel.

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Date Created: [YYYY-MM-DD]

12

SPLASH SCREEN

A splash screen may be created when the application requires a longer start-up. The user is then made aware of that the application has been started even if the functionality is not yet available.

The iron mark should be the focus and the application name presented below in Volvo Broad.

An abstract image can be used in the background as long as the colouring complements the iron mark and it does not take away focus from the logo and name. The image should have something to do with the functionality of the application.



In the example, the image behind shows a woman standing in a conference room. This is a subtle allusion to that the application is used for finding suitable rooms for meetings.

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Date Created: [YYYY-MM-DD]

13

START SCREEN

The start screen should be minimalistic and show a good overview of the functionality of the application.

A bright and clear background will allow the content to breathe and be the focus of attention.

Small graphical elements can be appropriate to create a balance in the appearance of the screen.

Place all choices above the fold and make the text left oriented for better readability.



Issuer: [Name] [CDS-ID] [Organisation] [Name of document] Security Class: [Proprietary]

Date Created: [YYYY-MM-DD]

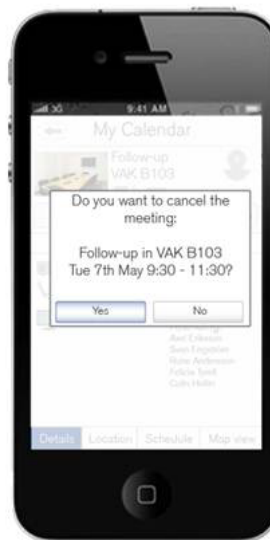
14

POP-UPS

Pop-ups are suitable when the user needs to confirm e.g. a reservation or cancel an action. They help avoid irreversible mistakes such as unintentional deletions.

A pop-up should require the full screen making any other interaction impossible. Something visual to indicate this blockade is recommended.

A maximum of 3 choices should be available in a pop-up. The choice confirming the action should be marked as shown in the image.



Example of pop-up designed to avoid unintentionally cancelling a meeting (irreversible action). The example uses a white fog with 75% opacity to enable the user to see in which function of the interface the action is made. The "Yes"-button is marked as it confirms the action of cancelling the meeting.

CLUES

Clues can be added to help the first-time user understand the interface more quickly.

The clues are only visible the first time the functionality is used as to not be disturbing. They are inactivated the first time by simply tapping anywhere on the screen.

The clues should only be activated the first time the application is opened, or if it has not been used for 2 weeks or more.



The clues in this example call the user's attention to certain functionality that might not be obvious.

They are designed with a blue background with 85% opacity in order to partially reveal the content behind. The text is 100% white and short and concise in its formulation.

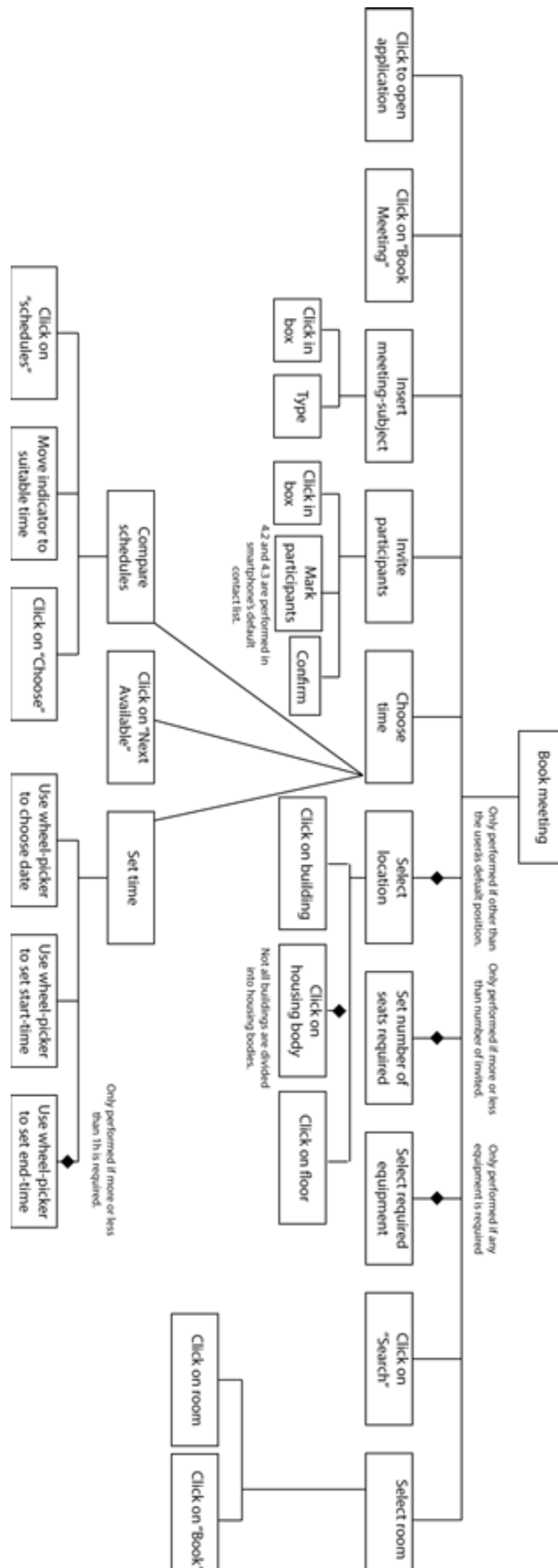
APPLICATION ICON

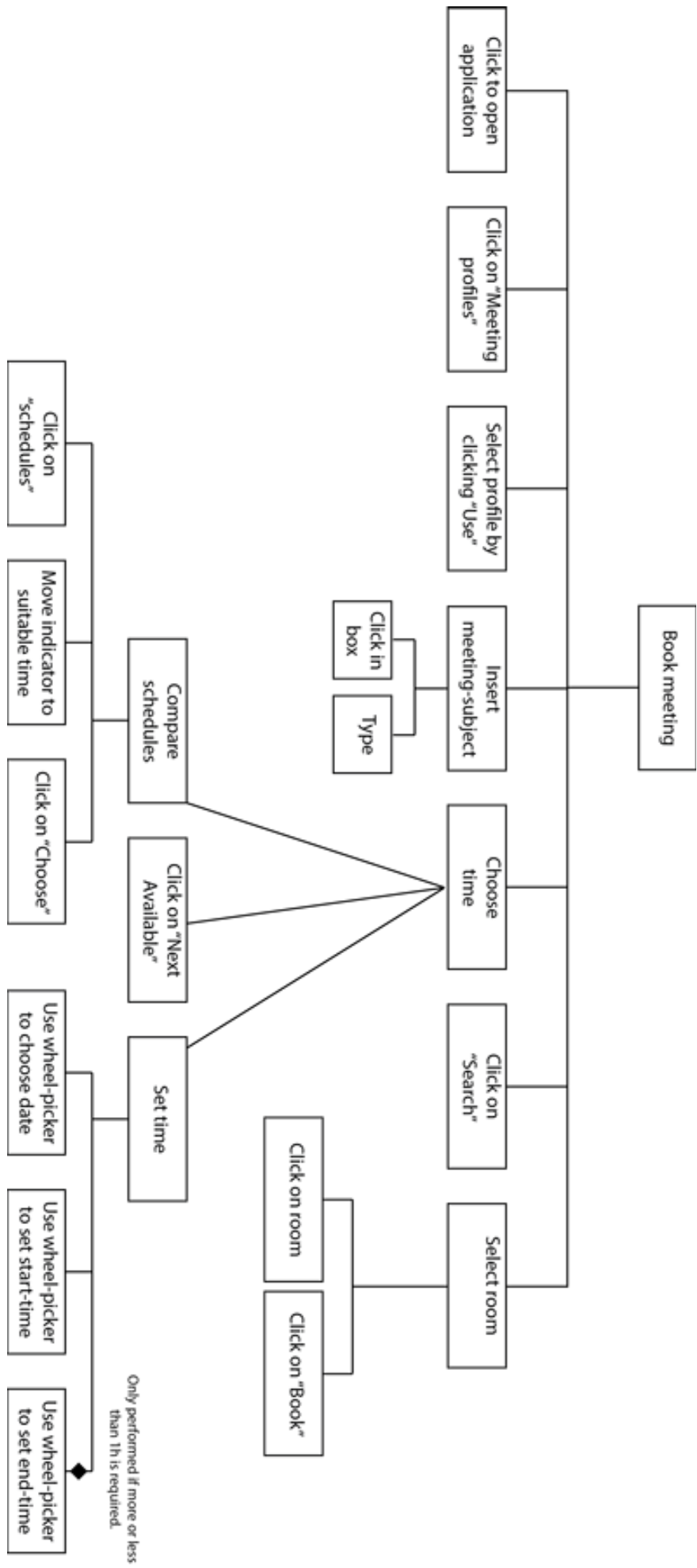
The start icon should be easy to see when quickly scanning the content of one's screen.

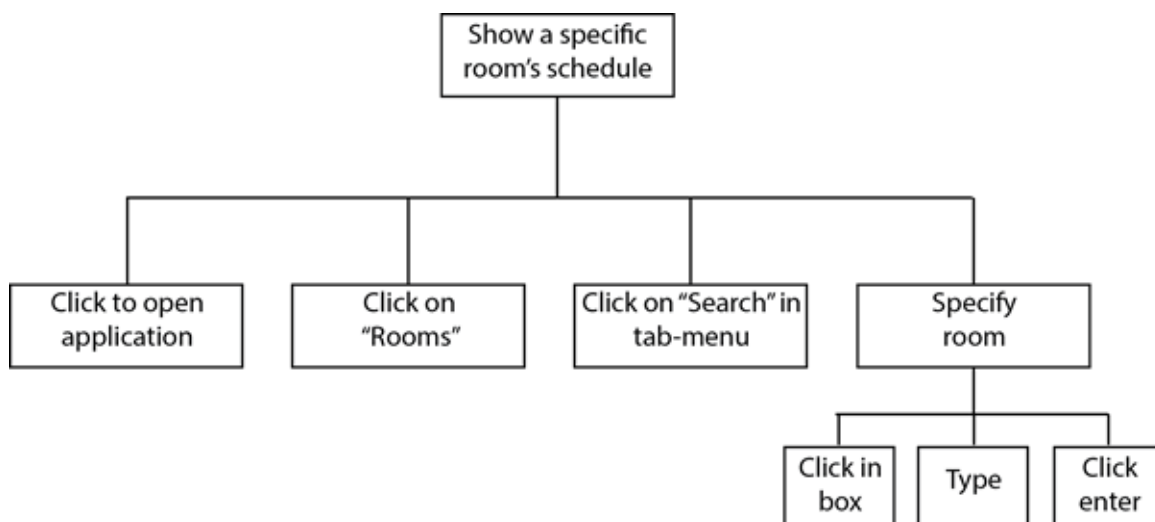
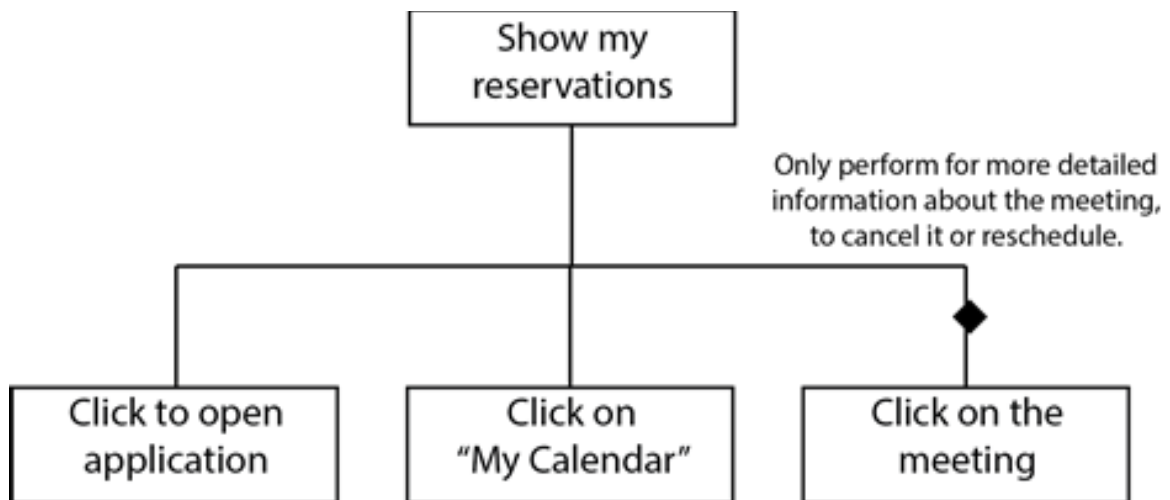
The design should be simple and clean with the Volvo mark and application name clearly visible.



15. HTAS OF FINAL CONCEPT







16. FINAL EFFICIENCY EVALUATION TABLES

Uses of keyboard			
Show my reservations			
	Max	Min	Prob
Microsoft Outlook	0	0	0
VROOM	0	0	0
Concept	0	0	0
Book a room			
	Max	Min	Probable
Microsoft Outlook (1)	6	0	2
Microsoft Outlook (2)	6	0	3
VROOM	6	2	4
Concept (1)	4	0	1
Concept (2)	1	0	1
Show specific room's schedule			
	Max	Min	Probable
Microsoft Outlook	0	0	0
VROOM	1	0	1
Concept	1	1	1

Number of clicks			
Show my reservations			
	Max	Min	Prob
Microsoft Outlook	4	3	3
VROOM	4	4	4
Concept	3	2	2
Book a room			
	Max	Min	Probable
Microsoft Outlook (1)	20	10	15
Microsoft Outlook (2)	23	12	15
VROOM	53	9	35
Concept (1)	28	11	15
Concept (2)	11	9	9
Show specific room's schedule			
	Max	Min	Probable
Microsoft Outlook	8	8	8
VROOM	12	6	6
Concept	5	5	5

17. REQUIREMENT FULFILLMENT TABLES (BASIS FOR PIE CHART)

Total	136
Accomplished	127
Partly accomplished	4
Possible to accomplish	2
Not possible	3
Design	
Accomplished	54
Partly accomplished	3
Possible to accomplish	
Not possible	
Handling	
Accomplished	38
Partly accomplished	1
Possible to accomplish	1
Not possible	
Functional	
Accomplished	39
Partly accomplished	
Possible to accomplish	1
Not possible	2

