

CHALMERS



Redesign of a mobile telephone exchange application

Evaluating and Enhancing the User Experience of Advoco's Mi application

Master of Science Thesis in the Master Degree Program, Industrial Design Engineering

ERIK DELLBORG

Master of Science Thesis

Redesign of a mobile telephone exchange application

ERIK DELLBORG

SUPERVISOR: EVA SIMONSEN

EXAMINER: PONTUS WALLGREN

Master of Science Thesis PPUX05

Redesign of a mobile telephone exchange application

Master of Science Thesis in the Master Degree Program, Industrial Design Engineering

© Erik Dellborg

Chalmers University of Technology
SE-412 96 Goteborg, Sweden
Telefon +46(0) 31-772 1000

Cover photo: Erik Dellborg
Print: Repro Service Chalmers

Acknowledgements

First I would like to thank Advoco AB for the opportunity to work on this project, in particular Sofia Alvenby for providing continuous input and feedback on the project, as well as providing various material. I also thank Richard McHugh for his commitment to the project and introducing me to the language of telephone exchanges.

I would also like to thank my fantastic supervisor Eva Simonsen, who has shared her knowledge and thoughts throughout all phases on the project, providing good insights and rewarding discussions along the way.

My opponent Minna Kristiansson also deserves many thanks, for using insights from her own project to give new perspectives to mine.

A special acknowledgement also goes out to Samuel Nilsson, who was not only the first to offer his participation in the usability evaluation, but whose visual representations of everyday situations served as a useful inspiration during the concept generation.

Great thanks also go out to all those who participated in the usability test, not only for their participation but for their insightful feedback and reflections.

Finally I thank my examiner Pontus Wallgren for his support throughout the project, providing both feedback and encouragement.

Abstract

This project describes the evaluation and subsequent re-design of Advoco AB's telephone exchange application Mi. The application connects its users to the telephone exchange of their workplace, thus replacing the need for a separate work phone. While the focus of the project has been on the mobile application available for Android and iOS devices, a PC client has been evaluated as well.

The goal of the project has been to enhance the user experience of the application, with much focus on the usability aspect. While a formative study served to identify issues to later address through a re-design, a baseline study was also conducted to facilitate measuring how well the Mi application supports its users. The methodology from the project may also be implemented by Advoco in subsequent evaluations, to ensure future development projects enhances the product's performance.

The structure of the project was determined by means of impact mapping, in order to connect the project goal to Advoco's end customers and their needs. The scope was also determined to encompass a re-design of the current interface and not a completely new product.

The evaluation resulted in a performance metric which Advoco may use as a basis for comparing and tracking the progress of their product development. Furthermore, a number of user experience issues were identified, and translated into requirements for a potential re-design.

The project resulted in several re-design of different parts of the applications graphical interface, as well as suggestions for alterations in the functionality. These were represented by descriptions of the underlying structure, as well as graphical concepts. The concepts were evaluated in terms of how well they fulfilled the requirements previously defined, as well as through a subjective usability evaluation.

Keywords: Interface Design, Mobile Application Design, User Experience, Telephone Exchange

Table of content

1. Introduction.....	1
1.1 Background.....	1
1.2 Purpose and goal.....	1
1.3 Deliverables.....	2
1.4 Limitations.....	2
1.5 Definitions.....	2
1.6 Sustainability implications.....	3
1.7 Report disposition	4
2. Product description.....	5
3. Theory.....	7
3.1 Usability.....	7
3.2 User experience.....	8
3.3 Mental models and generic knowledge.....	8
3.4 Formative, Summative and Base line evaluation.....	9
3.5 Requirements and guidelines.....	9
3.6 Mental workload.....	10
3.7 Approaches to design of digital interfaces.....	11
4. Methods.....	13
4.1 HTA.....	13
4.2 User profile.....	13
4.3 ECW.....	13
4.4 Impact mapping.....	14
4.5 Use cases and Scenarios.....	14
4.6 Interviews.....	15
4.7 Usability Testing.....	16
4.8 Affinity Diagram.....	17
4.9 Brainstorming.....	17
4.10 Focus Groups.....	18
4.11 The five whys method	18
5. Procedure	20
5.1 Overview.....	20
5.2 Impact mapping.....	21
5.3 Non-empirical evaluation.....	21
5.4 Usability testing.....	21
5.5 Requirements elicitation.....	22
5.6 Concept development.....	22
5.7 Concept evaluation.....	22
6. Impact mapping.....	23
6.1 Impact goal.....	23
6.2 User (usage) groups.....	23
6.3 User goals.....	24
6.4 User group demands on functionality.....	24
6.5 Metrics.....	25
7. Non empirical evaluation.....	26
7.1 Mobile application.....	26
7.2 PC-client.....	28
8. Usability evaluation.....	30
8.1 Users.....	30
8.2 Use cases.....	30

8.3 Test procedure.....	32
8.4 Delimitations.....	32
8.5 Quantitative results.....	32
8.6 Quantitative analysis.....	35
8.7 Qualitative results.....	38
8.8 Qualitative analysis.....	39
8.9 Summary of usability test results.....	39
9. Requirements elicitation.....	41
9.1 Mobile client.....	41
9.2 PC-client.....	43
10. Concept development.....	45
10.1 Functionality analysis.....	45
10.2 Concept generation.....	48
11. Final concept.....	53
11.1 Home screen.....	53
11.2 Messages.....	54
11.3 Forwarding Rules.....	56
11.4 Transferring Calls.....	58
11.5 Finding Contacts.....	59
11.6 Missed calls and voicemail.....	62
11.7 Further development suggestions.....	63
11.8 PC-client.....	64
12. Concept evaluation.....	66
12.1 ECW of new concepts.....	66
12.2 Requirements fulfilment.....	67
13. Discussion.....	71
13.1 Results discussion.....	71
13.2 Procedure discussion.....	73
13.3 Future recommendations.....	77
14. Conclusions.....	78
15. References.....	80
15.1 Online sources.....	81
15.2 Verbal sources.....	81
Appendixes.....	82

1. Introduction

In this chapter the background, purpose and goal for the project is presented, along with related information which is useful to further reading of the report.

1.1 Background

Advoco is a Stockholm based company that develops and sells cloud based telephone exchanges, primarily for small to medium sized companies. Their solutions combine a private branch exchange (PBX) with a connection to the public telephone grid, without any fixed installations at the client firm. Through a web based interface and applications for smartphones and PCs, the end users are able to stay connected to the exchange, benefiting from a number of functions such as call forwarding, transferring calls, call groups etcetera. The smart phone and PC application is the focus of this project.

As the product offer involves a high degree of end user interaction, Advoco has a need to ensure that the interaction provides the user with an as pleasurable and efficient experience as possible. Since they rely very much on resellers, they rarely interact directly with their end customers, there are limited possibilities to receive customer feedback, and thus other means of user evaluation are necessary. For this reason, they have sought to initiate this project.

The Mi application can be installed both on a smartphone and a personal computer, and provides the user with the functionality of a telephone exchange, including the ability to transfer calls, create forwarding rules, send internal messages and more. This provides flexibility in the terms that the user can be reached on the same number regardless of which device is available, and also easily manage the calls appropriately without the need to use the company's internal phones. A more thorough description of the applications functionality is presented in chapter 2.

1.2 Purpose and goal

The purpose for this project is to aid Advoco in appealing to their customers through the interaction with their products. A secondary purpose is to help Advoco make sure any changes in their products have the intended effects, and to ensure the users' experiences of their products continues to improve.

The goal of this project is to enhance the user experience of Advoco's mobile application Mi, by means of identifying areas for improvements and creating concepts of how such improvements may be implemented. The secondary goal is to provide Advoco with a methodology for future evaluation of their products, to allow them to track how the development of their products affect the users' experiences.

1.3 Deliverables

Once the goal of the project has been reached, the result will be presented to Advoco in the form of a number of deliverables. These are:

- Identified issues presented in a way so that Advoco can easily address them
- Suggested design solutions to issues identified during the evaluation
- General design guidelines for future development of the application
- Performance metrics and methods for future comparison

1.4 Limitations

The project involves the evaluation and improvement of the end user application Mi. The application is available as a mobile client for iOS, Android and Windows Mobile, as well as a PC-client for computers running OSX and Windows (7 and later). As the application differs slightly in appearance for the different platforms, the project will be limited to the mobile application for iOS and Android, and the PC-client for Windows, as these are the most commonly used platforms.

Where there are differences between the chosen platforms, the analysis will consider how these affect the test results, and which conclusions can be drawn with the differences in mind. Suggested improvements and concepts will be focused on the selected platforms, but can naturally where translatable be applied to the other platforms.

The final concepts should also constitute re-designs of the current interface, rather than a completely new product. While functionality and appearance may be altered, added, or removed, the underlying application should in principal remain the same.

1.5 Definitions

Below is presented a the definition of a number of terms and concepts, as used throughout this report. Many terms are specific for the area of telephone exchanges, and knowledge of them is critical to understand the functionality of the Mi application.

- A Private Branch Exchange, or **PBX**, is a telephone exchange that connects a number of local devices to each other. Often used by companies to facilitate internal communication, they may or may not be connected to the public telephone grid.
- **Forwarding** calls means that the user instructs the PBX to direct incoming calls bound for their device to another user. This means that the call never reaches the user's phone, but instead goes directly to for example a colleague or voicemail.
- **Transferring** a call means that a user receives and accepts a call, and subsequently directs the call to another user. This can either be done by first calling the person the call is to be transferred to to ensure the recipient will take the call, or by transferring the call directly without checking.
- A **Softphone** is a computer program that connects to the phone grid (either private or public), allowing the user to place calls via the computer.

- Interactive voice response, or **IVR**, is a way of communicating with a caller when the recipient does not answer the call. It can be as simple as a recorded message informing the caller that the person cannot be reached, or more advanced, letting the caller connect themselves to instance in the PBX by pressing buttons on their phone. An IVR can also be used as a first response or greeting, informing the user that they have successfully reached the company.
- An **Internal contact** is a contact that is connected to the same PBX as the user.
- An **External contact** is a contacts that is not connected to the same PBX as the user, who exists in the users native phone-book or similar.
- **Native** is a term used to describe functionality or elements that are built into the user's device. For example, the native phone-book of the user stores all the user's regular contacts, whereas the Mi application can access the native phone-book and present them on its own.
- **Forking** is a term used to describe how calls are directed when a user has more than one device connected to the same phone number. For example, a user might want to receive some calls on their mobile phones, and other calls on their softphone.
- **Screen** is a terms used to describe what is shown on a mobile phone at any particular point. For example, a home screen may denote the first screen that appears once an application is opened, and a call screen may denote what is visible on the phone during an ongoing call.
- A **Contact Card** is, while in principal a screen, the visual representation of all information pertaining to a contact, as displayed on the user's device. Thus this is a screen which may vary in appearance between contacts, depending on the information and functionality available.

1.6 Sustainability implications

While digital products tend to have less ecological impact than physical products, as the production and lifetime cost in terms of materials and energy is significantly lower or non-existent, sustainability can still be a significant aspect of the product design. In the context of this particular product, the Mi application, perhaps the most significant aspect is reducing the need to have a work phone separate from the user's regular mobile phone. Providing the same functionality as a regular phone connected to a PBX, and providing the reachabilty of a work mobile phone can significantly reduce the amount of devices needed to uphold full telephone related functionality.

Apart from reducing the amount of devices needed in a workplace, providing the functionality of a PBX based telephone system at a low cost affordable to smaller businesses can have effects of an economical nature. More efficient customer and internal communication can reduce the amount of time and resources placed in activities which are of little value to the end customer, and thus create a more viable business.

Increasing usability and the user experience for a product such as the Mi application could thus have a positive impact on sustainability, as it may prompt more users to utilise the product and thus benefit from the aforementioned effects. Additionally, reducing frustration and time spent not achieving certain goals with a product might

reduce work related stress in the users, thus adding health benefits to the positive effects.

1.7 Report disposition

The first chapters of the report is structured in the following way:

- **Product description.** A more detailed description of the Mi application is presented, to familiarise readers with the functionality and interface.
- **Theory.** An account of theory which is relevant when reading the report and interpreting the result and analysis.
- **Methods.** A presentation of the methods used throughout the project, as described by various literary sources.
- **Procedure.** A description of how the project was carried out in terms of which methods followed which, which results were used as input to subsequent methods and briefly how the methods were carried out.

Following these chapters, more detailed accounts of how methods were carried out, their results, and analysis, will describe each step of the project. Those chapter are:

- **Impact mapping.** A description of how the outline and strategy of the project was created by a step-wise break down the goal of the project into which parts were needed to reach it.
- **Non-empirical evaluation.** An evaluation used to predict problems in the interaction with the different interfaces, without input from actual users.
- **Usability testing.** Empirical tests where users were given a number of tasks to perform with the Mi-application, intended to show where problems actually arose.
- **Requirements elicitation.** A description of how the result from the evaluations was translated into a number of requirements to be used in subsequent product development.
- **Concept development.** A description of how the requirements were addressed when creating suggestions for re-designs of the Mi-application.
- **Final concept.** The result of the concept development, described in terms of visual representations and changes to the flow of the interface.
- **Concept evaluation.** A non-empirical evaluation to test whether the newly developed concept better supports a user.
- **Discussion.** A discussion of how the project was carried out, what could have been done differently, and which circumstances had which effects on the outcome. Discussion also includes how the result compare to the purpose and goal of the project. Additionally, recommendation for future work is presented here.
- **Conclusions.** An account of which major conclusions can be drawn from the result of the project.

2. Product description

In this chapter, the functionality and interface of the Mi-application is presented. Below is a digram (Figure 1) with screenshots from the application, which displays some of the most important screens in the interface. Each screen is also described in the subsequent list.

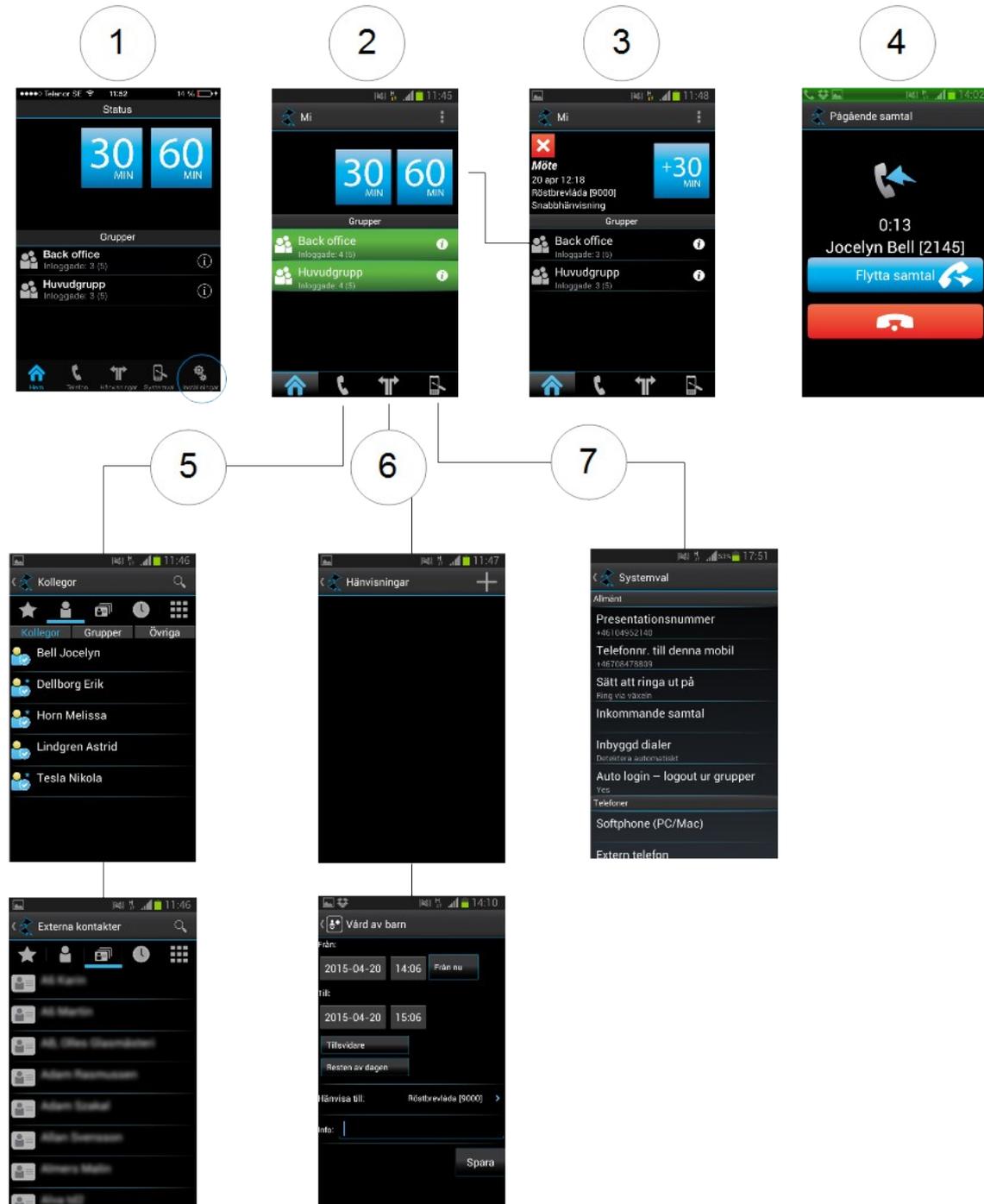


Figure 1: Diagram of current interface

1. The home screen of the iOS version of the application. All other images are from the Android version, as the differences are minute in the displayed screens. The most noteworthy difference between the home screens is that the iOS version has five icons in the bottom menu, whereas the Android version has four. The rightmost icon (circled) on the iOS version is instead placed under the menu accessible in the rightmost top corner on the Android version.
2. The Android version home screen.
3. The home screen while a forwarding rule is active, and the phone does no longer receives calls.
4. The screen that appears once the application is opened during an ongoing call, displaying the functionality to transfer calls.
5. Clicking on the phone icon in the bottom menu takes the user to a screen displaying contacts. Different selections of contacts may be displayed by pressing the different icons in the top menu. The magnifying glass icon indicates where a search function is available.
6. Clicking on the forwarding icon takes the user to a screen where they may view existing forwarding rules, or create new ones.
7. Clicking on the icon for system tuning takes the user to a screen where various settings are presented. There is also a second settings menu, accessible by the rightmost icon on the iOS home screen bottom menu (1), and by the top right button (the three vertically aligned dots) on the Android version (2).

3. Theory

In this chapter a description of theory used throughout the project is presented. Much has been written about usability, user experience and digital interfaces, and in this section a selection of some sources' views is described, with focus on subjects related to this project in particular.

3.1 Usability

The definition of usability according to ISO is “*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). Effectiveness relates to the users ability to achieve the goal at all, effectiveness regards how much effort is needed, and satisfaction incorporates how comfortable the user feels whilst using the product (Jordan, 1998 pp 5-7)

A product that is highly usable for one person may, however, be less so for others. Jordan (1998, pp 8-11) describes certain user characteristics, or rather categories of characteristics, which may all affect the usability of a product. One of the most prominent characteristics is experience, in the sense of how well acquainted the user is with the product or similar products, so that a more experienced user achieves their goal with higher effectiveness, efficiency and satisfaction. Poorly designed products may, however, diminish this effect.

Similar to experience is domain knowledge, which regards more general experience with the task and context. A user who has extensive knowledge of telephone exchanges may for example use the Mi-application more efficiently than a user without such knowledge. Other factors include cultural background, disabilities, age and gender (Jordan 1998, pp 8-11).

A number of components can be described, to highlight different aspects of usability. Jordan (1998, pp 11-16) describes the following five components.

Guessability relates to how well a user manages to complete a task the first time. While guessability will by nature matter mostly in the short term use of a product, a lack thereof may deter consumers from a product that might have been easy to use in the long run. The first impression can often greatly influence a purchase decision.

Learnability regards how easily a user reaches a level where tasks are completed with high effectiveness, efficiency and satisfaction, as opposed to the first time interaction of guessability.

Experienced user performance (EUP) refers to how well acquainted users perform their tasks. While learnability regards how easy that level of proficiency is reached, EUP regards the performance of the interaction is at that level.

What can be considered a upper level of EUP is called system potential. This is the theoretically highest possible level of performance, for example the lowest amount of clicks required to perform a certain task with a computer.

The final component listed by Jordan (1998, pp 11-15) is re-usability. This component relates to how well a user fares with a product which has not been used in a long time. This time must be considerably more than what can be seen as a normal time between the completion of tasks, or the measure will rather fall under EUP or learnability.

3.2 User experience

As Lallemand et al. (2015) conclude, there is no generally accepted definition of user experience (UX). They do however conclude that most experts agree that good usability is required for good UX, and that other significant aspects includes pleasure, emotional response and which meaning users ascribe to a product.

On this note, Desmet & Hekkert (2007) defines three types of experience, the first of which is aesthetic experience. While most often associated with the visual sense, this encompasses a products ability to elicit positive response from any of the human senses. The second type of experience is the experience of meaning, relating to what a user associates a product with, through recognition, memory etcetera. The third type is emotional experience, relating to the emotional response a product triggers in a user. An example could be that a roller coaster triggers a mixed emotion of fear and safety, which some find highly positive.

For this project, the following definition of User Experience of a product, based on the two previous paragraphs, will be used:

The user experience of a product is the difference between the state of the user prior to the contact with the product and and the state during any point during or after the contact.

The term 'states' is used to encompass the multiple dimensions of user experience described by Lallemand et al. (2015). As any number of states can be defined (e.g. emotional, pleasure, goal fulfilment etcetera), the definition can be used to describe any number of experience dimensions, for example a user's emotional experience, a user's experience of pleasure or a user's experience of goal fulfilment.

Encompassing both any time during, and any time after contact with the product describes that the user experience might (and will most likely) change depending on at which time it is observed. A user might experience a certain emotional state while getting into their car in the morning, and a completely different one when it fails to start at a stop light, or a few years after the car has been disposed of.

3.3 Mental models and generic knowledge

When a user interacts with a product, they build a mental representation of how the products work, called a mental model. Rook (2013) defines a mental model as:

“A concentrated, personally constructed, internal conception, of external phenomena (historical, existing or projected), or experience, that affects how a person acts.”

From this can be seen that mental models affect how users act in response to their idea of how a product will work. It thus become obvious that knowledge of users' mental models of a product is essential to designing highly usable products. Mental models can be compared to what Cooper et al.(2014, pp. 112) calls represented model, which is a representation of how the design of the interface acts and looks. Ideally the users' mental model will deviate as little as possible from the represented model, but this is not always the case. Furthermore, implementation models describe the internal construction of the interface. This should, however, not serve as a basis for how the other models are constructed, as the important relation is between mental model and represented model.

Mental models often help users predict how a product or system will behave during a certain task (Osvalder & Ulfvengren, 2011, pp. 386). Correct mental models thus help users perform better at the tasks at hand, however, should the user's mental model not correspond to the actual workings of the product, this can seriously diminish the performance.

Generic knowledge is a concept which describes certain knowledge that it can be assumed all (or nearly all) users have. Depending on the type of product the level of knowledge may vary (Osvalder & Ulfvengren, 2011, pp. 386). For example, most people would struggle to make sense of the output from an EKG-machine, whereas in the realm of medical practitioners this would be considered general knowledge. To design usable products it is thus necessary to have a good grasp of what can and cannot be considered general knowledge amongst the likely users.

3.4 Formative, Summative and Base line evaluation

A distinction can be made between three different kinds of usability evaluations, formative, summative and baseline. Formative evaluations are conducted to find usability issues in a design, with the intent to subsequently address and correct them. Such evaluations often take place during the product development process, and often occur in an iterative manner. The goal is to address as many issues as possible before the product is launched, and alterations are difficult or impossible (Tullis & Albert, 2013, pp. 43).

Summative evaluations look more to give a rating of a product, and are typically performed after a product or concept is relatively finalised. Looking less towards specific problems and more to a general perception of how well the product allows users to achieve their goals, they are often used to determine if requirements have been met. Other uses include comparisons between products or concepts, or to benchmark against competing products (Tullis & Albert, 2013, pp. 42).

Somewhat similar to summative evaluations are what Albert et al.(2010, pp. 20) describe as a baseline evaluation. Such evaluations are conducted in order to find some form of baseline to which subsequent designs may be compared, for example in a summative evaluation.

3.5 Requirements and guidelines

Goals, requirements and guidelines are defined by Bligård (2011, pp. 55 – 68), in relation to how they define a product's attributes and characteristics. The author define certain distinct characteristics of the concepts.

A goal is defined as what the product (or human machine system) should in fact perform and achieve. Goals are derived from the needs of the users, along with the tasks they are to perform while interacting with the product, and are defined at the early development stages. The functionality is then described in terms of how the product should perform in requirements.

Requirements should not be solution specific, i.e. they should for example not describe how a certain function should be implemented, but rather how it should perform. An example of this is that a requirement should rather read *“The user should only have to log in once to use the application”* than *“The application should store the user login-information on their device, using MD5 hash encryption”*. This is to ensure the requirements does not limit the ways in which functionality can be implemented, before design decisions are made. Some solution dependency will always be present, such as how the examples above both depends on the solution that users have to log in to access their application. This dependency naturally increases along with which design decisions are made.

Further, requirements must be measurable, in the sense that it should be possible to determine if a developed concept holds up to the requirement. For example *“Users should easily be able to access the phone book”* is difficult to measure, whereas *“During a usability test, 90 % of the users should be able to reach their phone book within five seconds and three clicks”* is relatively easy to evaluate. This adds a dimension of specificity to requirements.

Guidelines on the other hand, can describe instructions for the design which are less specific or more difficult to measure. An example of a guideline could be *“High contrast between background, and text and symbols, should be used to ensure visual clarity”*. While it might be difficult or meaningless to quantify the level of contrast, the guideline can still serve an important purpose in providing the users with easy to read text and symbols.

Goals, requirements and guidelines all come in different abstraction levels, depending on the stage of the product development process, and which design decisions have been made. As the development process progresses, the goals, requirements and guidelines gets more and more specific, and more clearly connected to solutions.

3.6 Mental workload

Mental workload is term used to describe the relation between what demands a task places on a person's mental resources, and what mental resources are available to that person (Vidulich & Tsang, 2012, pp. 245). These two constituents, demanded resources and available resources, work very similar to any other situation which places demands on a persons capabilities. When the demand only makes up a small portion of the available resources, the mental workload is small, and when the demand starts to approach the limit of the available resources, the mental workload becomes high. Once the demands exceed the available resources, failure to complete the task (within the limits of the context) becomes likely.

The unused mental resources can be thought of as spare capacity, and allows the user to direct their attention and information processing capacity towards other tasks. There is, however, a division of the mental resources in terms of which modalities they relate to. Such modalities include whether the task at hand demands perception and processing or responses, whether the information is spatial or verbal in nature and whether the primary sense used is audial or visual. Differences between focal and ambient vision can also be made (Vidulich & Tsang, 2012, pp. 246).

Thus tasks who place demands on the same modalities will compete more over the same (and thus more limited) resources than those who place demands on different modalities. An example is how it is possible to give a verbal response while playing a

computer game, whereas listening to an audiobook while reading a newspaper is bound to fail (Vidulich & Tsang, 2012, pp 245 – 247).

Mental workload can be measured in several different ways, encompassing subjective experience, performance and physiological manifestation. While the more objective types of metrics (performance and physiological responses) might yield more exact data, subjective measure can be useful for explaining the mechanisms that have an impact on performance, and when comparing different designs Vidulich & Tsang (2012, pp. 253 – 254).

3.7 Approaches to design of digital interfaces

Cooper et al. (2014, pp. 300-310) list three interface paradigms, representing different principles of thought for designing digital interfaces. The first is referred to as implementation-centric interfaces, and is built around the idea that the user controls each existing function directly, so that the user's behaviour exactly reflects the inner workings of the machine. While such interfaces are extremely easy to build, they require a user to learn a lot about how the machine is constructed in order to operate it. While the user has full control over every aspect of the machine, the usability of the interface tends to be utterly depleted.

A more desirable yet far from perfect principle is that of metaphoric interfaces. This principle utilises metaphors for the functionality, derived from how similar functionality works in the “real world”. Examples include a picture of a pair of scissors to describe a “cutting” function, a depiction of an envelope to describe a message service, or a house icon to return a user to a “home screen”.

While there are benefits to working with metaphoric cues, in the sense that users often intuitively know what to do, there are several drawbacks. Some mentioned by Cooper et al.(2014, pp. 302-305) include that some concepts are inherently impossible to describe in metaphors (such as processes or relations), the meaning of metaphors may vary between users, and that it ties the interface to how the analogue world works.

This last drawback, that the interaction is tied to how the physical world works, is perhaps the most vital, as it limits the system potential. As described earlier (see chapter 3.1), the system potential describes the maximum level of efficiency with which a user can use the product. Tying the interface to the inefficiencies of the physical world means that the potential of the digital world cannot be fully used.

The third and, according to the authors, most favourable principle is idiomatic interface design. With this principle, the interaction is built up similar to verbal idioms, for which humans have an outstanding aptitude to learn. This is in fact how much of the functionality in computers and hand-held devices works today, as most interactions are based on previously learned “idioms”. Drop-down menus, swiping gestures and clicking hyper-links are not metaphorical representations of real-world phenomena, but rather short snippets of interaction the users have learned previously.

From their description of the paradigms of interaction design, Cooper et al. (2014, pp. 301-310) state a number of design principles:

- “Most people would rather be successful than knowledgeable”. This relates to that most people (engineers are stated as the exception by the authors) would rather easily interact with a product, than completely understand its inner workings.

- “Never bend your interface to fit a metaphor”. This means that the inner workings of the interaction should never be designed to fit a metaphor, but if a metaphor fits naturally it may still help.
- “All idioms must be learned; good idioms need to be learned only once”. The basic principle is that when properly designed, idiomatic interfaces require the user to only perform a task once in order to learn how to do it. This is equal to high learnability.

4. Methods

In this chapter the methods used throughout this project are presented, as described in literature. Note that not all methods were performed exactly as they are described here, but some alterations occurred.

4.1 HTA

Hierarchical task analysis (HTA) is a method for breaking tasks down into their constituent parts. This is done by first formulating the overall goal of the task, i.e. what is to be accomplished. This goal is then broken down into subordinate goals, or actions, to be accomplished. These subordinate goals are then broken down further until the desired level of detail has been reached. A common depiction of an HTA is that of a hierarchical diagram (see Figure 2). Depending on the purpose of the HTA, the desired level of detail may vary (Bligård, 2011, pp. 107).

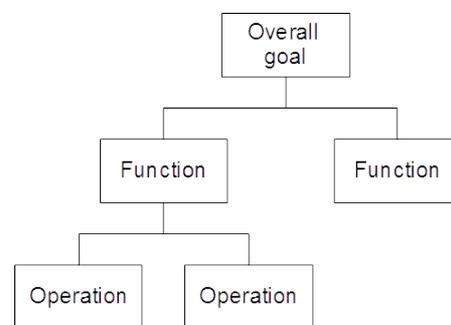


Figure 2: Illustration of HTA-diagram

4.2 User profile

A user profile is used to describe certain characteristics of current or intended users of a product. Such characteristics often include physical and cognitive abilities, but also encompass education, training, experience and other traits that may be required to perform certain tasks. The exact characteristics used to describe the user vary with the type of product to be investigated, as for example physical strength may be highly significant when operating a heavy hand-held tool, but insignificant when setting an alarm on a mobile phone.

An important aspect of the user profile is to also include critical users, who may have significantly lower capabilities in some aspects than the average user (Bligård, 2011, pp 106).

4.3 ECW

An enhanced cognitive walk-through (ECW), as described by Bligård & Osvalder (2013) is a method for predicting usability problems in certain interactions with a product. Having performed an HTA for the task to be investigated, each “box” in the diagram is analysed by asking a series of questions regarding how well the user will

perform that particular task. An important distinction in this analysis is how functions and operations are treated slightly differently. Operations are found at the bottom level of the HTA, and can generally not be broken down further (at least not meaningfully). Examples can be “press red button”, “turn dial” and “hear beeping sound”. All boxes above the operations are considered functions, and consist in several operations, and sometimes of several functions.

During the ECW a top-down process is applied, so that the uppermost functions are analysed first. The questions asked may be adapted to fit the interface, but should regard whether the user will know that the function is available, if any clues present will be associated with the correct function, and whether the user will receive sufficient feedback during and after the function is performed.

Once the functions have been treated the operations are analysed. While the questions are similar, the focus is on how well the operation connects to the user's goal, and how well the interface lets the user perform and understand the operation in relation to this goal.

Answering the questions is done by rating the likelihood of success, on a scale from 1 (very low chance of success) to 5 (very high chance of success). This is then accompanied by a failure/success story explaining the answer. When a usability problem is detected (a rating of 1-4) this is also categorised by what the underlying cause of the problem is, such as insufficient user knowledge of the machine, hidden clues, or excessive physical demands put on the user. Thus, knowledge of the user, the use situation, and the task, is required to perform a meaningful ECW. Once the analysis is complete, the result is compiled, commonly in matrix form.

4.4 Impact mapping

Ottersten and Balic (2010, pp. 46 – 59) describe in their book a methodology for product development in IT-projects they call impact mapping. The core idea is to always have a clearly defined goal or a desired impact for the project, in a way that can be measured and controlled. This goal should then be linked to every step of the project, to ensure all activities actually contribute to the goal in an efficient manner.

Another core principle of effect mapping is that all success in IT based product development must stem from the users, and more particularly the users' goals. The idea is to look at how the goal of the project can be achieved by aligning the product with what the users need in order to achieve their goals.

While primarily directed towards the development of new products, the methodology can easily be applied to projects concerned with evaluation or redesign of existing products. In such cases, the methodology ensures that anything measured actually relates to the users' goals as well as the project goal, and that the actual use of the product stays in focus.

4.5 Use cases and Scenarios

A use case is a generalised description of a use situation. While commonly used to describe human-machine interaction, use cases may also be used to describe machine-machine (or human-human) interaction. Use cases are constructed by defining preconditions for the interaction, such as the user (actor), the machine's status prior to the interaction, and the context. Following this, the sequence of events that constitute

the interaction is defined, with variations and alternative routes included. Failed interactions may also be considered, depending on the purpose of the evaluation (Bligård 2011, pp. 108).

Scenarios are, like use cases, a description of a use situation, but is more narrative. The importance lies in explaining what the user experiences during the interaction, in terms of thoughts, emotions and goals. The purpose of a scenario is generally to make the use situation feel more life like and relateable (Bligård, 2011, pp. 108).

4.6 Interviews

A common method for gaining knowledge about users' interaction with a product is to conduct interviews. While a multitude of variations exist in terms of interview procedures, Cooper et al. (2014, pp. 44-56) propose a framework for what they call ethnographic interviews, as it relates to how anthropologists observe human behaviour.

The first step is to formulate a persona hypothesis. This is a first brief description of which types of people might use the product, what their goals are, which differences there might be in their traits, and which roles they might have. This is highly comparable to defining the users during impact mapping Ottersten and Balic (2010, pp. 50). This is then followed by planning and scheduling the interviews to be conducted.

Three different stages of interviews are described by Cooper et al. (2014, pp. 50-51), including early interviews, middle interviews and late interviews. Early interviews are performed to gain domain knowledge from the users, and are highly explorative in nature. The focus is on open questions, and letting the users paint a broad picture rather than focusing on details.

Middle interviews usually occur later and are more focused on confirming patterns and finding details. The questions tend to be more specific, and aim to help the interviewer find information related to more precise design goals.

Late interviews are mainly conducted for confirmatory and clarifying reasons, employing closed questions related to assumptions and hypotheses.

Cooper et al. (2014, pp. 51-56) also provide some recommendations for performing interviews. A key aspect is to perform interviews in a context as similar as possible to the context where the product will be used, preferably the actual environment where the user will use the product. This allows the interviewer to make observations not only regarding how the user interacts with the product, but also how the user interacts with the surrounding. The user might, for example, require various "cheat-sheets", perform tasks in a certain order, or interact with their colleagues in a certain way.

Other principles include not having too fixed a set of questions. This is basically logical, since the reason the interview is conducted is that the interviewee has a lot of knowledge and behave in ways that the interviewer are not aware of. Thus it is unlikely that the interviewer will be able to predict all relevant questions ahead of the interview. Instead the focus should be to have a set of topics to be addressed during the interview. With these as a foundation, the questions can then be adapted to fit the course of the interview. This is also referred to by Bligård (2011, pp. 88) as semi-structured interviews.

Other recommendations are to allow the user to "show-and-tell", i.e. use mediating objects to explain how they behave in a certain situation. Storytelling is another way of letting the user explain how they behave and interact with the product and context in a

narrative form rather than answering a lot of questions.

Further, leading questions should be avoided, such as “You use this frequently, do you not?”. Additionally, Cooper et al.(2014, pp. 54-55) suggest that the interviewer should avoid discussing the technology behind the product with the user, or having the user suggest design modifications themselves. The authors argue that the reason for the interview is to learn about how the user interacts with the product, not how the user would like the product to be designed. While such suggestions might not be useful solutions to the problems at hand, they may however provide insights into why the user would consider that a good solution (i.e. divulging the underlying problem), and discussing the technology could provide insight into the user's mental model of the product.

4.7 Usability Testing

To evaluate how well a product design allows users to perform certain tasks, usability test may be conducted. A usability test normally consists in letting a user interact with a product and observing how well the product supports the user in accomplishing certain tasks. While the ideal is to let users test a real product, various kinds of product representations may be used instead, should for example the product be unfinished. The assumption is that problems that occur during such tests will likely occur during actual use of the product as well (Bligård 2011, pp. 94).

A method for usability testing described by Jordan (1998, pp 71-72) is referred to as controlled experiments. Controlled experiments are performed by letting a user (or several users independently) perform a set of tasks using a certain product. The idea is to control as many of the variables surrounding the interaction as possible, in order to be sure any usability issues discovered can actually be attributed to the interface, rather than circumstance. This includes the tasks to be performed, the order in which to perform them, the products settings prior to the test and any modifications made to it during the test.

By controlling these aspects, the influence of knowledge transfer from one task to another may be reduced or accounted for. If the user, for example, is to change a setting by selecting a function from e menu early in the test, and then change another setting under the same menu later, such knowledge transfer may occur and influence the result. While the user might struggle with the first task, the second task might be performed without effort if the user has seen the second function during the first task. Thus the result might imply the interface supports the second task much better, whereas a follow-up question like “How did you know where to look for this function?” might clarify that this is not the case.

A disadvantage to a very controlled experiment is that the use situation becomes more artificial than the actual use environment might be. This could affect the test result in several ways, having both positive and negative effects on the users' performance. It might be that the user usually performs the task in a stressful environment with many distractions, in which case the test score will be (falsely) better during the test. It might also be that the user is afraid of appearing inexperienced or simply daft while being observed, and does not dare to try and explore for the fear of failing. Such impacts must be taken into account while analysing the results of controlled experiments (Jordan, 1998, pp. 71-72).

Another useful method to elicit user reactions to an interface is a so called think-aloud

protocol (Jordan, 1998, pp. 57-58), in which the user is encouraged to describe what they are thinking while interacting with a product. The interaction may be free and explorative, or follow a set of predetermined tasks, such as in a controlled experiment described above. This can generate a lot of qualitative data which the user might not recall if for example interviewed after using a product.

While the observations (direct or from recordings) of a user test, such as a controlled experiment, may yield a lot of qualitative data, especially if a think-aloud protocol is applied, several types of quantitative data may also be of interest. These may include number of successfully completed tasks, time per task, number of clicks or how often help was required (Bligård, 2011, pp. 94).

On the subject of how many user tests should be conducted there is no commonly agreed upon number. Nielsen & Landauer (1993) argue that the number of usability problems found in a usability test is equal to:

$$P = N(1-(1-L)^n)$$

Where P is the amount of problems found, N is the total amount of problems present in the product design, L is the probability that a user finds a previously undiscovered problem and n is the number of test subjects. They also provide an estimated mean for L of 0.31. This gives that with five test subjects, 85 % of the usability problems will have been discovered. It should be noted however, that only problems associated with the functionality actually tested will be included (if a menu is not used during a test, then no problems associated with that menu will be discovered). They also add that the number may become higher should the complexity of the interface grow significantly.

4.8 Affinity Diagram

An affinity diagram (also referred to as KJ-analysis or KJ-diagram after its originator Jiro Kawakita) is a method for compiling and organising large amounts of qualitative data. The data can either be generated in connection to the method, or be the result of a previous method (Bergman & Klefsjö, 2010, pp. 541-545).

The purpose of an affinity diagram is to identify common themes amongst the pieces of data and group them accordingly. Often this is done by having the individual pieces of data on paper notes and physically placing them in groups. These groups are then summarised in a short description of what the underlying data means, thus concentrating the essence of the data. These groups may be further grouped if the number of groups is high, and relations between the groups are noted.

Once grouping is completed, a number of themes have emerged. This correlate to how Auerbach & Silverstein (2003, pp 35-41) describe the transition from raw text, via repeating ideas and themes, to theoretical constructs and narrative. In essence, the qualitative data is by grouping transformed into a basis for formulating theories.

4.9 Brainstorming

Brainstorming is a method often used in ideation stages of product development, and is a way of generating a multitude of solutions without mixing feasibility and criticism into the creative process. Generally a group of participants express any ideas they can come up with, and associate freely around each other's ideas. Criticism and screening is performed later, as the key to brainstorming is quantity over quality. Often even the most far fetched idea can hold merit in some aspect, and it is important to document

everything and anything the group can come up with (Bligård, 2011, pp 122).

A variation of brainstorming is called brainwriting, and works in a similar way. The distinction is that each person generates their ideas without interacting with the other, noting them down on a piece of paper. This can give a greater diversity among the ideas, as the participants are not influenced by each other. Once the ideas have been written down, the participants reveal their ideas to the group, one by one, until all ideas have been presented. After this the ideas may either go through refinement, or subsequent sessions of brainstorming or brainwriting may be performed, building onto the first ideas (Bligård, 2011, pp. 122).

4.10 Focus Groups

Focus groups can be used during several stages of a product development process, and is performed by a group of people discussing one or more aspects of a product design. Often a predetermined set of topics set the outline of the discussion, with a moderator ensuring deviations from the topics are avoided, but otherwise the discussion is free. Common purposes are to get opinions, experiences of a product, suggestions for further development or idea generation. The use of mediating objects, such as the product itself or a representation thereof, prototypes, related products or artefacts from the use context can help spur the discussion, and increase the diversity of the discussion (Bligård, 2011, pp. 88).

4.11 The five whys method

Pojasek (2000) describes a method for finding root causes to problems and issues, called the five whys method. The core principle is that when describing problems, people tend to describe symptoms rather than causes. This can, however, according to the author be alleviated by continuously seeking the root cause of a problem by asking “Why?” several times. The author states that the transition between symptom and cause often occur around the fourth or fifth iteration, which is the reason he advocates asking “Why?” at least five times.

An example to illustrate the process is presented below.

Problem: Users do not want to use the application for calling their colleagues.

1. *Why do users not want to use the application?*

They claim it is too bothersome.

2. *Why do they find it bothersome?*

They say it takes too much time.

3. *Why does it take too much time?*

They have to go through several screens to find the right contact

4. *Why do they have to go through so many screens?*

Because they fail to use the available shortcut

5. *Why do they not use the shortcut?*

Because the shortcut icon is too small and the symbol is not intuitive.

While one could of course continue to ask “Why?”, the above example have served to narrow a quite wide problem, a reluctance to use an application, into a single icon. Addressing how to make the icon more visible and intuitive is much more straightforward than addressing the problem of why users do not want to use the application for a certain task.

5. Procedure

In this chapter, a description of the project's procedure is presented. The main focus is on displaying the chronology of the project, and how methods were used, including in which way the various results were subsequently used.

5.1 Overview

The project planning was broken down into three main phases. The first phase was focused on impact mapping and preparation for the evaluation of the application. This included identifying users, the most essential functions of the application, and in which way the interaction could be measured. This was complemented by an Enhanced Cognitive Walkthrough of the most important functions, in order to better pin-point any possible interaction problems.

The second phase consisted in conducting evaluative tests, compiling the data from these and analysing the information. The key focus of this phase was to find and describe any existing issues in the interaction, and how the result connected to the impact goal.

The third and final phase involved using the outcome of the previous phase to improve the application with regard to the user experience. During this phase the aspects deemed most critical during the analysis were addressed, and solutions to the issues regarding the interaction were developed.

In Figure 3 below is an activity diagram showing the principal outline of the project.

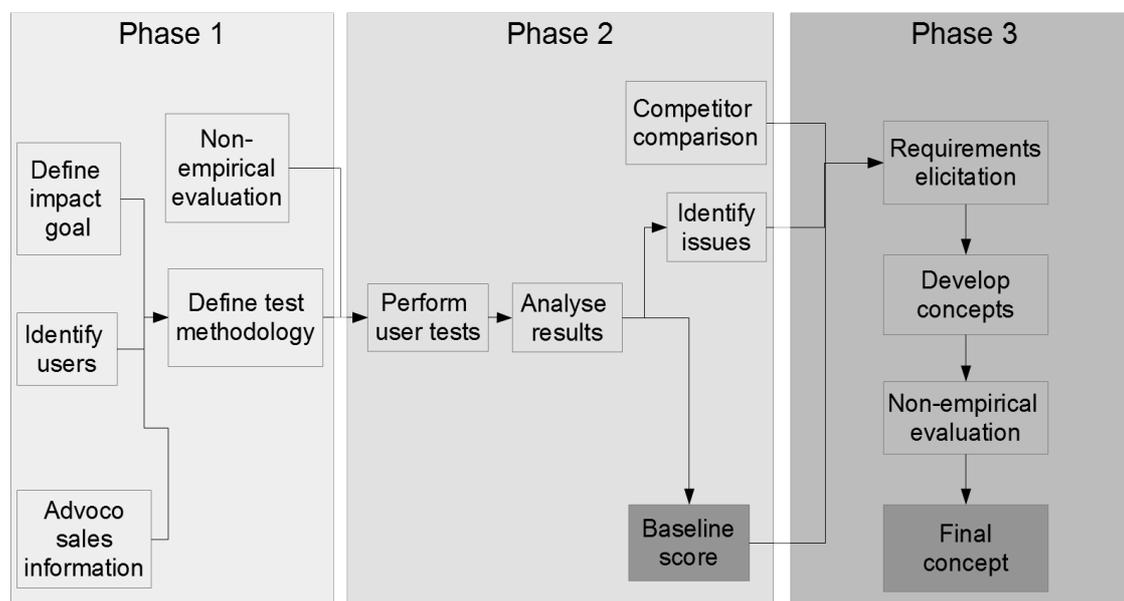


Figure 3: Project procedure overview

5.2 Impact mapping

The impact mapping was the first method to be conducted, as it is intended to shape the layout of the project. First the impact goal was determined, derived from a more long term goal, in collaboration with the company. Following this three user groups were described, based on their main reasons for using the Mi application. Basing the grouping on the usage of the application rather than demographic data or similar was done since this offered a more meaningful distinction between the groups, and made the following step more straightforward.

The following steps were to formulate user goals for the three groups, based on how they would benefit from using the application, and to determine which demands these goals placed on the existing functionality of the application.

Once the demands placed on the application were formulated the final step of the impact mapping commenced, consisting in determining what had to be performed in order to reach the impact goal, based on the users, their goals and their demands. This resulted in a procedure for conducting evaluations of the application, what to measure, and how to use and analyse the result.

5.3 Non-empirical evaluation

To complement the impact mapping in preparation for the upcoming user experience evaluation, a non-empirical evaluation was performed. This was done by first performing an HTA for the user interaction with the application, and subsequently an ECW for a number of critical tasks. The tasks were chosen in part based on information from Advoco's sales department (Alvenby, 2015) regarding the most commonly used functions, and in part to encompass a large part of the interface.

5.4 Usability testing

Combining the result from the impact mapping and non-empirical evaluation, a usability test was designed. The purpose of the test was both to perform a baseline evaluation using quantitative data to receive a score as to how well the interface supports the user groups, and to find possibilities for improvements of the interface for a subsequent re-design using qualitative data.

First a basic user profile was created, to ensure the test participants would in fact reflect the real users of the application. Once the users were defined the test procedure was created, translating the functionality to be tested (as per the result of the impact mapping and non-empirical evaluation) into use cases, and subsequently a complete test procedure. Methods and principles for documentation and gathering data were decided upon, and a script was formulated.

Two pilot tests were conducted and the test procedure was revised into its final form. Following this 19 usability tests were conducted, reaching a point where little new qualitative data emerged during the tests, in accordance with the thoughts of Nielsen & Landauer (1993) on saturation of data.

The quantitative data, based on objective counting of clicks required to perform each task and subjective self assessment of difficulty by the users, was compiled and translated into performance and difficulty scores. These scores were then used to identify which tasks were affected by the most severe usability problems.

The qualitative data were transcribed from the recorded tests, and compiled using the principles of an affinity diagram. This was done in steps, turning the data into a number of statements describing the most critical issues of each task. These statements were later used to find potential solutions to the problems, by determining the nature of the problems.

5.5 Requirements elicitation

The result of the quantitative and qualitative analysis was later translated into requirements to be placed on a future re-design, with the purpose of addressing and solving the problems. The requirements were elicited using the 'five why' methodology, finding the root cause of the problem. Additionally, some requirements were defined by analysing how the underlying problem was solved in other, similar products.

5.6 Concept development

Translating the requirements into concepts was done in two stages. During the first stage the requirements were analysed as per which functionality they related to. This consisted in determining whether they would require an existing function to be altered, if there was a need for completely new function, or if the required functionality existed in some other product, from which inspiration could be had.

The second stage involved converting the requirements and descriptions of affected functionality into actual specifications for concepts. To do this a focus group was held, with five participants brainstorming and brainwriting around possible solutions. The result of the ideation was then compiled into descriptions and depictions of how the solutions could look and work.

The more complex solutions, in terms of them needing new visual elements, significant changes to layout or a new underlying structure, were expressed as visual concepts. The visual representations were largely created by utilising existing visual elements from the Mi application, along with some newly created. The more basic improvements were, due to limited time and their simplicity, rather described verbally than visually.

5.7 Concept evaluation

Once the concepts had been created they were subjected to a non-empirical evaluation, in order to ensure they actually had potential to improve the users' interaction with the application. This was done by conducting an ECW on the new interface, with functions and operations affected by the changes to the design.

6. Impact mapping

In this chapter, the procedure and result of the impact mapping is described.

6.1 Impact goal

The first step of impact mapping is to set a goal for the project. In collaboration with Advoco, two goals were determined, one more long term and abstract and one more intended for this particular project. The first goal was:

“To become the preferred telephone switch supplier”

This was translated to the context of the particular project into:

“To increase the value users gain from the Mi application, by enhancing the User Experience”

This latter goal was chosen to place focus on the relation between the value a user gain from a product and their experience of the product; while there are several ways of increasing the value a user receives, the focus of this project is on the UX aspect.

Determining whether the first goal has been met is a matter of measuring whether sales have increased, and determining Advoco's market share. Measuring the second goal can be done by a summative evaluation, comparing the performance of the current design to a later re-design. In order to identify how the goal may be reached, a formative evaluation of the current design is required, to identify any current issues. Thus both a formative evaluation and a baseline evaluation (to later be used in a summative evaluation) are needed to complete the project.

6.2 User (usage) groups

Once the goal had been set, the users were identified. Instead of isolating certain demographics, the users were grouped by what benefit they were to gain from using the application. In this way, any user could naturally be found in any of the three groups, however defining the goals became more straightforward. The user groups, or rather usage groups were determined as:

- Users who benefit primarily from **Increased availability**. The benefit stems from customers being able to reach the user to a higher extent, for example since the user does not have to be at an office or similar to be connected to the company's telephone exchange. An example could be a hair dresser, who mainly use the phone for receiving reservations. For them, a missed call is quite likely a missed income.
- Users who benefit primarily from **More efficient communication with customers**. This benefit occurs once the customer has reached the user (or company), and may involve transferring the call to an appropriate department. An example is a customer service department, where the users should only have to call one number, and then the recipient can connect them to whichever department is best suited to attend to their need.
- The final group consist in users who benefit from **More efficient internal communication**. This benefit comes from a better flow of information within the company, for example by allowing colleagues to send messages when they

are unavailable for calls. Such users will typically include organisations or parts of organisations where many internal activities need to be synchronised, but the communication with external actors is limited. An example could be a user working in an accounting department at a company. Typically they will need to keep track of the financial transactions of several departments, but have little to no customer contact.

These usage groups encompass different aspects of the most common use situations. As mentioned above there is naturally some overlap between the groups, as it is for example difficult to imagine an application that was terrible for internal communication but works extremely well for external communication. Thus the usage groups will rather help when interpreting the results. Should, for example, a certain function be shown to work poorly, it is easier to connect it to the main goal of the project by showing which type of usage it affects.

6.3 User goals

For each of the user groups, a user goal was also determined. This goal served as input into which functions and aspects of the application should be evaluated, as well as what measurement should be used. The goals were, respectively:

- An external caller should, using a single number, always be able to reach a final destination in the telephone exchange, and should always be able to convey a message.
- An external caller should easily and promptly be able to reach the correct person. Should the caller fail, any employee should easily be able to take the call and transfer it to the right person
- Communication between colleagues should be easily initiated and facilitated. When colleagues are unavailable other means of communication, or alternative colleagues, should be conveniently presented.

These goals further help explain the result of the evaluation, in terms of showing which goals poor functionality may hinder a user from achieving.

6.4 User group demands on functionality

With the goals set, the existing functions of the application were categorised by which user goals they related to. Not all functionality was taken into account, as some functions were, in collaboration with Advoco's sales department (Alvenby, 2015), deemed to be used extremely rarely. Such functions were mostly various settings, such as choosing whether or not to dial via the PBX. Naturally some functions relate to more than one user goal

The functions as categorised are listed in Table 1 below.

Increased availability	External communication	Internal communication
Handle missed calls	Transfer calls	Instant messaging
Listen to / Configure voicemail	Finding contacts	Finding contacts
Configure incoming calls	View colleagues status	View colleagues status
Forking devices	Forwarding rules	Forwarding rules
IVR	IVR	
Call groups	Call groups	

Table 1: Functionality demands per user group

This categorisation served the purpose of connecting the evaluation result to the final goal, which is a core concept in impact mapping. It also served as input for creating the usability test, showing what functionality needed to be addressed.

6.5 Metrics

With the functionality to be tested defined, the next step was to decide on what to actually measure, and how the results would then be categorised and presented. For the baseline evaluation it was decided that the number of clicks to perform a task, number of tasks not completed, and a self assessed difficulty rating were to be used. The difficulty rating was set on a five point scale from one to five, one corresponding to “not difficult at all”, and five corresponding to “nearly or completely impossible”.

An alternative to clicks would have been measuring the time needed to complete each task, but this was deemed less suitable for two reasons. Firstly, time would depend slightly on the performance of each user's own device (as each user using their own device was seen as most suitable, to reduce the influence of an unfamiliar device). Measuring time, a user who struggled to complete a task while using a high performance device could possibly achieve the same score as a user who perfectly completed the task on an older, slower device. Comparing to an ideal path of action is also easier when clicks are used, as the ideal time to complete a task is more difficult to define, and will also depend on the device used.

Self assessed difficulty was chosen since there is not necessarily a causal connection between number of steps to complete a task and how difficult a user experiences it. Most people will likely find it less difficult to dial a ten digit phone number (ten clicks) than to connect a projector to a laptop (typically much less than ten clicks). Self assessed difficulty could thus be seen as an estimation of the user's mental workload while completing the task, as described in chapter 3.6.

For the formative part of the evaluation qualitative data were deemed the most advantageous, as such data tends to relate to why users behave the way they do, rather than how well they actually perform. When the goal is to improve an interface, finding the cause of users' behaviour is key. The qualitative data to be collected included comments made by users while interacting with the Mi application, observations on their behaviour, and answers to predetermined interview questions.

7. Non empirical evaluation

In this section the non empirical evaluation methods performed during the project are described. While a brief description of the procedure has been presented earlier (chapter 2), the following sections will describe the procedure in more detail, and present the result and analysis.

7.1 Mobile application

With basis in the impact mapping, an HTA of the users' interaction with the Mi application was created. The three figures below (Figure 4, 5 and 6) show the HTA at a function-level, divided into the three usage groups. Operation level HTA of the most significant functions identified in the impact mapping are found in Appendix I.

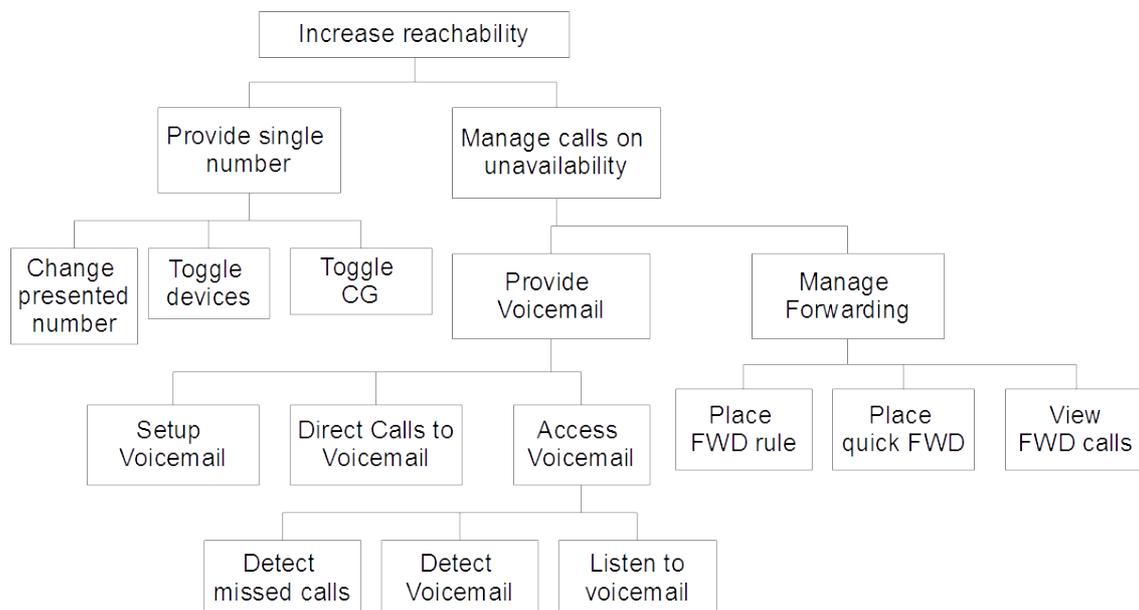


Figure 4: HTA for usage group Increase Reachability

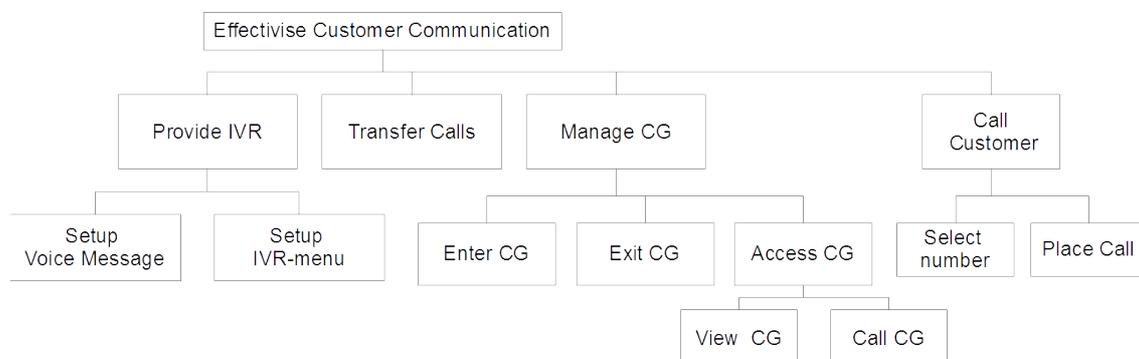


Figure 5: HTA for usage group Effectivise Customer Communication

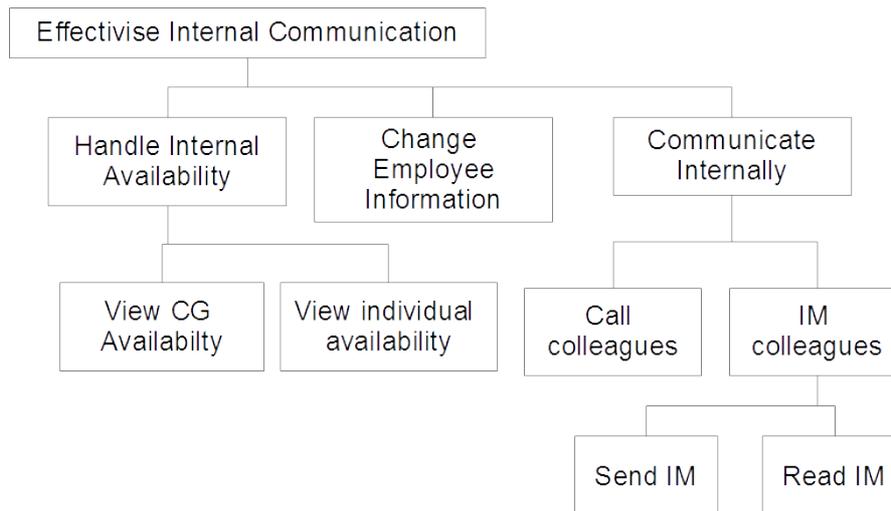


Figure 6: HTA for usage group *Effectivise Internal Communication*

Following the HTA analysis, an ECW was conducted for the functions listed below. Based on the impact mapping, these tasks were deemed to involve much of the functionality the user goals placed demands on. Further, they encompass a large part of the interface.

- Handle groups
- Call a contact (includes opening contact card)
- Place forwarding rule
- Send instant message
- Transfer call

The complete result of the ECW:s are found in Appendix II. For time saving purposes separate ECW:s for iOS and Android were not conducted, instead notes were made when any difference was deemed to affect the outcome. The purpose of the evaluation was formative rather than summative or baseline, in the sense that it was to primarily provide a basis for creating user tests. Predicting where interaction problems might occur, as well as their nature, forms a starting point for defining the tasks the users are to perform in order to identify where problems actually do occur. Thus the emphasis of the analysis was on finding the functions and operations most likely to cause a problem, and which parent-functions this would effect, rather than compiling the result into quantitative gradings.

The most problematic aspects of the interaction is presented and explained below.

- Searching for contacts can cause problems, particularly for Android users, since the operation of pressing the search bar is hindered by the fact that the search bar is difficult to find
- Calling a contact might confuse users insofar that they might not know the difference between the listed numbers, nor that pressing them issues the call.
- Transferring calls depends on the user having knowledge about how to navigate

from the native call screen of the phone to the application. Without such knowledge, it is unlikely the user will succeed in transferring a call without relying on guessing.

- Handling groups have some problems, including that there is no clue to indicate that pressing groups logs in and out of them. Additionally, the icon to view group members is small and difficult to recognise. Further, if the user is the last to log out of a group a prompt will ask if they still want to log out. Some users will likely not know what this means. Calling a group from the interface might also cause problems, as the users might think this can be done from the home screen or while viewing the group.
- The symbol for entering the Forwarding screen is not obvious. Users might however still manage this without problems by the process of elimination, as the other icons in the bottom menu are intuitive.
- While the buttons for quick forwarding are large and visible on the home screen, there is no indication that they actually relates to forwarding, other than a slight suggestion by the indicated times.
- The messaging function is hidden within the hierarchy, and thus difficult to find without prior knowledge. Further, on Android devices the text field for entering a message is all but invisible.

7.2 PC-client

While the PC client looks fairly similar to the mobile application, there are of course notable differences. Perhaps the foremost difference lies in the fact that a computer is very different from a cellphone, which will likely have a strong effect on users' mental models of the applications.

Due to the limited time frame, the PC-client was not subjected to a user test, but rather a modified version of an ECW/PUEA analysis, with focus on comparison. For each task in the user test of the mobile application, a number of questions were asked regarding the PC-client, regarding if the user was likely to perform better, the same or worse performing the task. The questions posed were the following:

- Is the user more or less likely to find the applicable function?
- Are the clues easier or more difficult to detect?
- Is the user more or less likely to associate the right clue with the right function?
- Is the user more or less likely to associate the function with the correct parts of the interface?
- Will the user get better or worse feedback to understand that the desired function has been performed?

This type of evaluation is a quite significantly modified ECW, and is largely unsupported by literature. Some of the key feature of the ECW method compared to the regular CW, as argued by Bligård & Osvalder (2013), is its ability to gain a high-level perspective of the interface by looking at whether the user will know or get clues as to whether a function is available, more extensive information about failure and success stories, and more easily overviewed results. These three aspects are all present in the applied modification of the method, as the function perspective is intact, the success

and failure stories are treated equally to the original method, and an overview is easily achieved.

The main disadvantage with this version of the method is that the level of detail on the operation level is significantly lower, as the questions are asked from a task perspective, rather than from an operational perspective. Naturally, as the result requires an evaluation of the mobile client to be meaningful, the evaluation cannot stand on its own, but should be seen as a preliminary evaluation

7.2.1 Result

The complete result is found in Appendix III. Generally, the PC-client was deemed to work better, particularly in terms of finding external contacts and discovering missed calls. The most notable issues were concerning placing forwarding rules and transferring calls.

Placing forwarding rules was mainly hindered by the fact that the functionality is hidden in a menu which reads “Settings”. Once found the procedure is as straight forward as with the mobile application, but the icon for forwarding rules in the app is significantly clearer.

Transferring calls in the mobile application is complicated greatly by the fact that the “Transfer” button only works for transferring between active calls. If a user wishes to transfer a call directly without calling the recipient first, the button will only show an empty menu, and the user instead has to click on the contacts number. It was deemed highly likely that this would significantly confuse many users.

As with the mobile application, the messaging function was hidden within the hierarchy. The presentation of sent and received messages was however found to be significantly better, in that it more resembled typical presentation of messages (Figure 7).

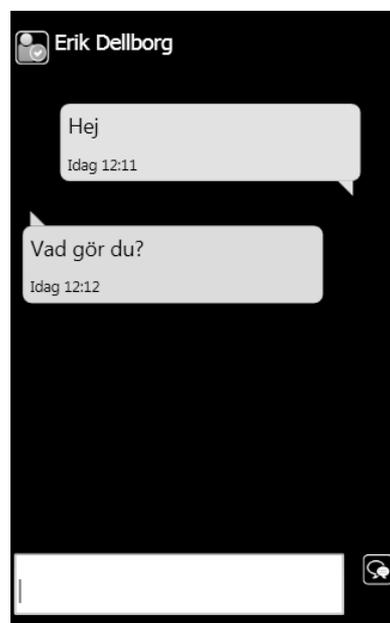


Figure 7: PC-client messages

8. Usability evaluation

In this chapter, the main usability evaluation of the mobile application Mi will be presented. No formal division between iOS and Android is made in the chapter structure; instead any significant differences will be treated where they appear.

8.1 Users

With the usage groups and goals found in the impact mapping (chapter 6) in mind, an attempt to create a user profile was made. It did, however, soon turn out that very few distinct characteristics could be identified, as both existing and potential users came from very diverse groups. Advoco's target group encompasses anyone employed at a small to medium sized company, who regularly uses their phone in their work (Advoco, 2015, A). As this can stretch from a young female with a summer job at an office to an old man working at a carpentry firm (both are examples given by Advoco's sales department), few assumptions can be made.

One characteristic that could be found was that the user should be accustomed to use a smart phone (since it is highly unlikely the person will start using a smartphone only to use the Mi application). Furthermore, if a person suffers from a significant cognitive or physical disability that affects the normal use of a smartphone, that person will likely need additional devices or the aid of a caretaker to perform any tasks, in which case the use situation would fall outside the scope of this project. Thus the typical user was only defined insofar as being accustomed to a smartphone, having used a phone in some sort of work situation, and not suffering from a significant disability.

In total 21 different users performed the user test, two of which performed pilot tests and have been excluded from the results. Of the 19 remaining, six were existing users who had used the application for at least six months. Eight participants used Android devices, one of which were an existing user, and eleven participants used iOS devices, five of which were existing users. While no conscious decision was made in that direction, all but two of the participants were aged between 23 and 31.

Further, all users were accustomed to using smartphones, and had at some point used their phone for work related tasks. Educational backgrounds included medical professionals, Android developers, engineering and physics student, business and finance, and sales and logistics. Thus a broad spectrum of backgrounds and work experiences was achieved.

The selection of users fulfilled and exceeded the number of test subjects proposed by Nielsen & Landauer (1993), with the exception for existing users with the Android version of the application. During the tests with existing users, it was noted that they did not necessarily perform significantly better than new users (some did, some did not). As this was the case, it was concluded that while some users might increase their performance with extended use, ensuring that all users were well supported by the application would require that new users (who could be seen as critical users) performed sufficiently well.

8.2 Use cases

From the user requirement elicited from the impact mapping, a number of use cases were created and compiled into a test script. The intent was to have the users test all

functions deemed significant, as well as a sample of functions deemed less significant but representative of for example handling settings.

Added to this test script a few elements from scenario building were introduced, such as having to perform some tasks as quickly as possible, or having a real incoming call to be transferred. The complete test guide is found in Appendix IV, and below is presented a short overview of the tasks presented to the test subjects.

- Call an external contact (previously added to the user's native phone book).
- Transfer an incoming call.
- Attempt to call a colleague (internal contact) but identify said colleague as busy.
- Send aforementioned colleague an instant message instead.
- View a received instant message.
- Place a forwarding rule, with “Care of child” as reason, start time one hour from now and end time the following morning at eight (coinciding with the feature “Rest of the Day”).
- Place a quick forwarding rule.
- Discover a missed call (placed by the test leader during a short break) and identify who it was from and what happened to the call (that it went to voicemail).
- Discover and listen to a new voicemail.
- Change the following setting settings:
 - Time until calls go to voicemail.
 - Changing so that all incoming calls go to a softphone and no incoming calls go to the mobile phone (referred to as forking).
 - Changing the outgoing number to hidden.
 - Changing so that quick forwarding rules send incoming calls to voicemail.
- Create a new favourites-list.
- Adding a colleague to newly created favourites-list.
- Finding which groups the user is logged into.
- Finding who else are logged into a certain group.
- Placing a call to a person in said group.

Between each task the user was told to return to the home screen of the application. While it might have yielded further information to see how users navigated between screens without starting from the home screen, this was necessary to give meaningful data regarding number of clicks.

Before each test begun all settings were set in a predefined way. This was also repeated during a break in the test between creating a quick forwarding rule and identifying a missed call.

8.3 Test procedure

The tests were conducted as a combination of a controlled experiment and an interview, with a think aloud protocol applied. Each user was told to perform the tasks listed above whilst describing what they were doing, and their reactions and reflections. Prior to, during, and after the test a number of predetermined questions were asked (see Appendix IV), and additional questions were asked based on what transpired during the test. The nature of the question related part of the test was thus that of an early to middle semi-structured interview.

During the test a camera recorded audio and the screen of the phone, as well as the user's hands, in order to facilitate subsequent click-counting and transcription of the verbal data. While most users used the application on their own device, some new users and all existing users used a device provided by the test leader (corresponding to their own devices operating system). For existing users borrowed devices were used to avoid interfering with the application they used for their work. The new users who used borrowed devices did so either because they did not wish to install the application on their phone, or because technical difficulties occurred during the installation.

Prior to the test all subjects were informed that they should not feel that they were the ones being tested, and that by definition only the interface could be at fault. A description of the application was given, along with explanations of certain key concepts, such as forwarding, call groups and softphone. All new users (who had had no previous contact with the application) were also presented with the quick guide, present in the application, in paper form (see Appendix V). This was done to represent an introduction to the application an existing user would have received from the vendor.

8.4 Delimitations

While measures were taken to ensure the test subjects were not afraid of making errors or say that they did not know how to perform certain tasks, any test situation will likely alter the behaviour of the user. As the test was focused on the mobile application, the users likely paid less attention to what else occurred on the phone. As the PBX communicates with the user not only via the application interface but also via e-mail and direct notifications to the mobile phone, a user might have performed better in a normal use situation. These effects were, however, limited to the tasks around identifying missed calls, voicemail and instant messages.

8.5 Quantitative results

The quantitative data were gathered by counting clicks per task for each user, and compiling the estimated difficulty figures. This data were then compared to the ideal path of action (IPA, least amount of clicks required) to provide a measurement of the application's performance. It is important to note, however, that the performance score must not be looked at alone, but always along with total amount of clicks and the IPA. This can be illustrated by an example:

Imagine two interfaces where the same task can be performed. For interface A the IPA is 20 clicks, and for interface B the IPA is 5 clicks. If a user clicks 25 times using interface A and 10 times using interface B, interface A will have a better performance score while interface B is clearly preferable. It might however imply that interface A is more intuitive, albeit less efficient. While looking at a single interface, the performance

score will, however, provide a good implication of which tasks are best supported by the interface.

Below are two diagrams (Fel: Det gick inte att hitta referensskällan and Fel: Det gick inte att hitta referensskällan) showing the performance and difficulty scores respectively. At the bottom a table of the IPA for each task is shown (Table 2). The performance score is calculated by dividing the IPA of the task with the average amount of clicks required by the users to complete the tasks. Naturally, a difficulty rating of one would be corresponding to the IPA for this metric.

The complete tables of data are found in Appendix VI.

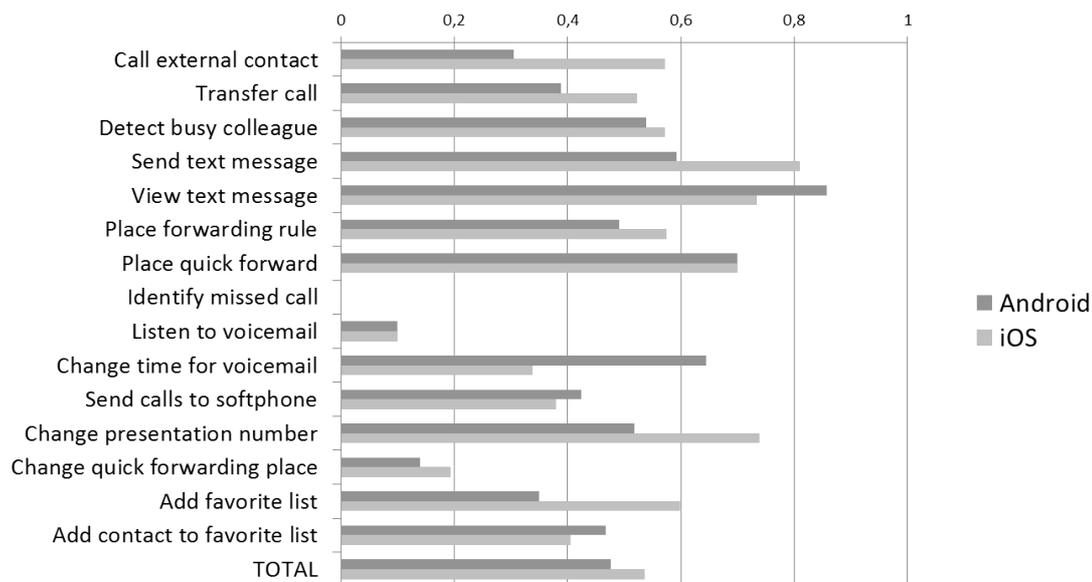


Figure 8: Performance score per task

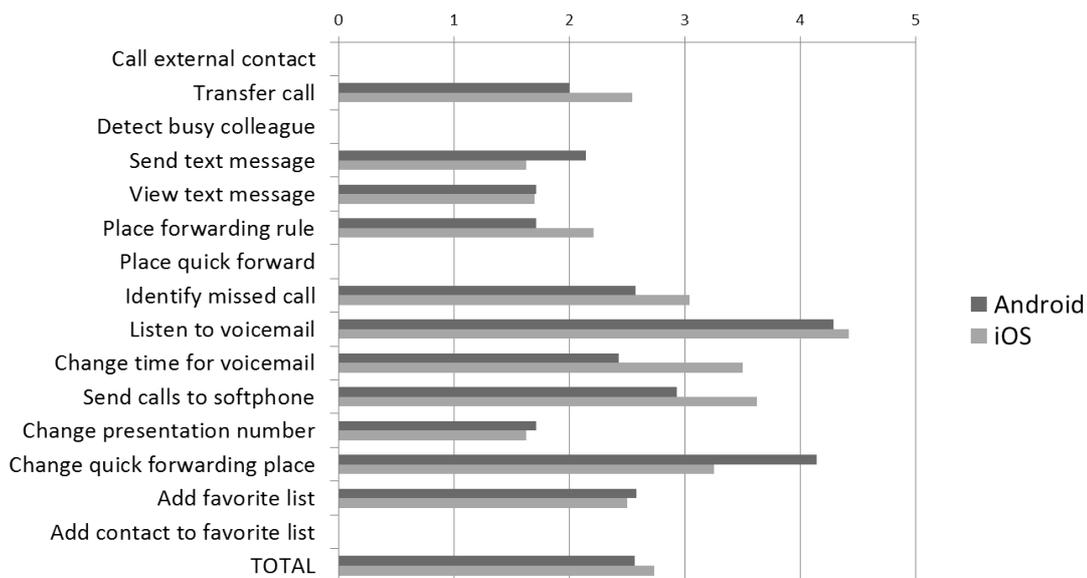


Figure 9: Difficulty rating per task

Task	IPA – Android	IPA - iOS
Call external contact	5	5
Transfer call	3	4
Detect colleague as busy	1	1
Send instant message	6	6
View received instant message	2	2
Place forwarding rule	8	8
Change time for voicemail	7	8
Direct calls to softphone (forking)	8	8
Change outgoing number	4	4
Change quick forwarding place	4	4
Add favorite list	5	5
Add contact to favourite list	4	5

Table 2: Ideal Path of Action (IPA) per task

Identifying a missed call largely took place outside the application, as many users identified the missed call via the phones native call handling, and was thus excluded. Further, as most users failed to find and listen to the voicemail, this performance score was instead calculated by dividing the number of users who successfully found the voicemail with the total number of test subjects. The alternative would have been to count the amount of clicks needed to reach the point where the users gave up on trying to complete the task. As some users out of curiosity tried for significantly longer time than others, this metric was deemed not to be meaningful.

Similarly, as several subjects placed a normal forwarding rule when tasked with placing a rule “as fast as possible”, the performance score was calculated by dividing the number of test subjects who correctly and immediately identified the quick-forwarding buttons, with the total number of subjects. This was done since placing the forwarding rule in the wrong way was considered closer to failing to perform the task than doing it inefficiently.

While transferring calls only the clicks made once the user had opened the Mi-application were counted. This was done since navigating to the application might need different amount of clicks depending on the device, and thus an IPA would be impossible to determine.

In the diagrams above, a higher performance score means the interface allowed for higher efficiency, whereas a higher difficulty rating means the users' subjective estimation of the tasks difficulty was higher. An absence of a bar in the diagram indicates the metric was not applicable to this task, or the data were too incoherent to be meaningful.

8.6 Quantitative analysis

Following this first compilation, the results were then complemented by weighting the performed tasks, as to how important they were deemed for each usage group. This was done in collaboration with Advoco (Advoco, 2015, B), and was a result of estimating how often a user has to perform the tasks, along with how likely it would be that a new user would encounter the task during the first interactions, thus shaping the first impression of the application. Each task was given a value from zero to two, with 0.5 steps.

The weighting (W) was combined with the performance score (PS) according to the formula below, to a contribution score (CS).

$$CS = (1 - PS) * W$$

Using '1 - PS' instead of simply 'PS' enhances the importance of the weighting, as can be seen from the following example:

An unimportant task with a weight of 0.5 has a high performance score of 0.8. An important task with a weight of 2 has a performance rating of 0.2. Their CS will be 0.4 and 1.6 respectively, showing that poor performance of a vital task contributes more. Had 'PS' been used instead of '1 - PS', both tasks would have contributed 0.4, which makes little sense.

The CS of all tasks was then added up, and compared to the sum of the weights (corresponding to a worst possible score with a PS of zero) for a total score TS. This score provides a general, weighted measurement of the interfaces performance. A lower TS means the interface is better suited for the evaluated tasks. The figures below (Figure 10 and 11) show the TS for Android and iOS respectively. The column to the right of the contribution score shows the same score with average estimated difficulty as a basis. This is calculated analogously, and as with the performance based contributions and total scores a smaller value means the test subjects found it less difficult.

Android

		Increase value provided by MI application through enhancing the User Experience									
		Increase availability			Effectivise communication with customers			Effectivise internal communication			
Performance	Difficulty	Weight	Contribution Score	Difficulty CS	Weight	Contribution Score	Difficulty CS	Weight	Contribution Score	Difficulty CS	
											Call external contact
Transfer call	0,4	2	1	0,61	0,25	2	1,22	0,5	1	0,61	0,25
Identify colleague as busy	0,5	1	0,46		2	0,92		2	0,92		
Send IM	0,6	2,1	0	0	0	1	0,41	0,29	2	0,82	0,57
View IM	0,9	1,7	0	0	0	1	0,14	0,18	2	0,29	0,36
Place forward rule	0,5	1,7	2	1,02	0,36	2	1,02	0,36	1	0,51	0,18
Place quick forward	0,7		2	0,63		2	0,63		1	0,32	
Identify missed call		2,6	2	0	0,79	2	0	0,79	1	0	0,39
Listen to voicemail	0,1	4,3	1	0,9	0,82	1	0,9	0,82	0	0	0
Change time for voicemail	0,6	2,4	0,5	0,18	0,18	0,5	0,18	0,18	0,5	0,18	0,18
Choose device for calls	0,4	2,9	1	0,58	0,48	0,5	0,29	0,24	0,5	0,29	0,24
Change presentation number	0,5	1,7	0,5	0,24	0,09	0,5	0,24	0,09	0,5	0,24	0,09
Change quick forward place	0,1	4,1	0,5	0,43	0,39	0,5	0,43	0,39	0,5	0,43	0,39
Create favorite list	0,4	2,6	0	0	0	1	0,65	0,4	2	1,3	0,79
Add colleague to favorite list	0,5		0	0		1	0,53		2	1,07	
Total	0,5	2,6		5,74	3,36		8,96	4,23		6,96	3,44
Total score (TS)				0,55	0,39		0,53	0,5		0,46	0,34

Figure 10 Weighted scores (TS) for Android

iOS

		Increase value provided by MI application through enhancing the User Experience									
		Increase availability			Effectivise communication with customers			Effectivise internal communication			
Performance	Difficulty	Weight	Contribution Score	Difficulty CS	Weight	Contribution Score	Difficulty CS	Weight	Contribution Score	Difficulty CS	
											Call external contact
Transfer call	0,5	2,5	1	0,48	0,39	2	0,96	0,77	1	0,48	0,39
Identify colleague as busy	0,6		1	0,43		2	0,86		2	0,86	
Send IM	0,8	1,6	0	0	0	1	0,19	0,16	2	0,38	0,31
View IM	0,7	1,7	0	0	0	1	0,27	0,18	2	0,53	0,35
Place forward rule	0,6	2,2	2	0,85	0,6	2	0,85	0,6	1	0,43	0,3
Place quick forward	0,7		2	0,63		2	0,63		1	0,32	
Identify missed call		3	2	0	1,02	2	0	1,02	1	0	0,51
Listen to voicemail	0,1	4,4	1	0,9	0,85	1	0,9	0,85	0	0	0
Change time for voicemail	0,3	3,5	0,5	0,33	0,31	0,5	0,33	0,31	0,5	0,33	0,31
Choose device for calls	0,4	3,6	1	0,62	0,66	0,5	0,31	0,33	0,5	0,31	0,33
Change presentation number	0,7	1,6	0,5	0,13	0,08	0,5	0,13	0,08	0,5	0,13	0,08
Change quick forward place	0,2	3,3	0,5	0,4	0,28	0,5	0,4	0,28	0,5	0,4	0,28
Create favorite list	0,6	2,5	0	0	0	1	0,4	0,38	2	0,8	0,75
Add colleague to favorite list	0,4		0	0		1	0,6		2	1,19	
Total	0,5	2,7		5,2	4,19		7,68	4,96		6,16	3,61
Total score (TS)				0,5	0,49		0,45	0,58		0,41	0,36

Figure 11 Weighted scores (TS) for iOS

From the tables above can be seen that the application performs rather similarly across the usage groups, while the main contributing tasks varied. Some of the most critical tasks, the improvement of which would significantly affect the total score, included:

- Calling external contacts (particularly for Android users)
- Transferring calls
- Creating forwarding rules
- Identifying missed calls
- Finding and listening to voicemail

Identifying a colleague as busy also contributes significantly, however, this score is likely quite skewed as several test subjects stated that they proceeded to call the colleague even though they immediately identified them as busy, since the test leader had told them to make a call. As the IPA for this task was a single click, even one extra click diminishes the performance score to 0.5.

The identified tasks provide a starting point for where improvement efforts may be targeted. While improvements may of course be made in other aspects as well, these tasks should provide the most significant opportunities for improving the overall performance of the application. The result could also be used to prioritise further, should for instance a certain usage group be targeted.

8.7 Qualitative results

The qualitative data were partly collected from notes taken during the usability test, and partly by transcribing the recordings. The transcription consisted in documenting the main content of what was said and the user's actions, rather than transcribing word by word or phonetically. Examples of noteworthy user actions include where the user looked for certain functionality, and if they performed certain operations in a particular order.

The transcribed material was grouped by task, and subsequently summarised into a number of statements per task, using the principles of an affinity diagram. The complete list of such statements (translated into English) is found in Appendix VII, Table 3 below shows the main problematic and helpful aspects of each of the tasks identified as critical in the previous chapter.

Task	Summarised statements
Call external contact	<ul style="list-style-type: none">• Phone icon works well• Phone screen is cluttered and there is a conflict between the labels "External contacts" and "Other"• Search function is difficult to find and only works for active tab• Main issue is that it is easier not to use the application than to use it when calling external contacts
Transferring calls	<ul style="list-style-type: none">• Main issue is to navigate from native call screen to Mi application• Once the application is open, few problems arise, and several users expressed that it was much easier than they thought it would be• Some users wanted better feedback as to what happened to the call
Creating forwarding rule	<ul style="list-style-type: none">• Most users found it to work well and being intuitive, yet few reached high efficiency• Clicking on the text to change time and date is not intuitive (iOS)• 'Rest of the Day' button is only noticed after the time has already been set• A created forwarding rule cannot be altered, but must instead be removed and a new one must be created
Finding and listen to voicemail	<ul style="list-style-type: none">• Without knowing that one must dial 9000 to listen to voicemail, it is impossible to perform this task• The users who did find their voicemail all did so via e-mail• Many users expressed that while e-mail delivery might be convenient, they do not want more e-mails• If a user sees a missed call and a new e-mail, most users check the call first• Users tended to search for the voicemail in proximity of the missed call or the contact who had called. Some also searched for a contact called "Voicemail" or similar
Identifying missed calls	<ul style="list-style-type: none">• The application itself gives no indication of a missed call• The missed call was often mistaken for two separate calls, as the call log has one post for the missed call, and one for the call having been sent to voicemail• Most users wanted a notification inside the application to see when there was a missed call

Table 3 Summarized statements for the most critical tasks

Apart from these statement, a number of additional pieces of data relating to the lower weighted tasks describe areas in need of improvement. Some more noteworthy were:

- The division of setting into two menus was seen as illogical
- A “save” option should be present for all settings
- The text field for messages is difficult to see on Android
- The message function is hidden in the hierarchy
- Several users used a different application for sending internal instant messages on their workplace
- Several users wanted to add colleagues to the favourite list directly from the list screen
- Several users found the Contact Card to be confusing, with no clear distinction between information (such as a telephone number) and functionality (such as sending messages)

8.8 Qualitative analysis

The qualitative data provide indications of why the application supported the critical tasks poorly. In some instances the cause is quite clear and was stated explicitly by the test subjects. For example, almost all subjects stated that they wanted an indication of a missed call both on the application icon on the native phone screen, and once the application was opened. Also, most subjects stated that there should either be a contact called “Voicemail” or a button while viewing the missed call to call voicemail directly.

More difficult to determine is why so many test subjects struggled with finding external contacts. Likely causes could be that the division of contacts into “internal” and “external” might be contradictory to the users' mental model of a phone book. Difficulty in finding the search function, and the fact that it only searches the active tab. While there was a noticeable difference between Android and iOS for this task, the only large difference between the screens is that the iOS app states “Internal contacts” while the Android application states “Colleagues”.

An interesting notion is that most test subjects found it rather easy to place a forwarding rule, while the performance score was quite poor. This indicates that while the interface lacked in efficiency regarding forwarding rules, it did not place much demand on the users' mental resources. This could be caused by the large amounts of operations available on the same screen. Providing a good overview, this layout may cause the users to feel confident in being able to perform the task (thus lowering the difficulty rating), while pressing several unnecessary buttons trying to find the precise one.

8.9 Summary of usability test results

In summary, a number of critical aspects of the interaction between the Mi application and the users have been identified. These seem to have the most severe effects on the users' experience of the application, and are thus the most urgent to attend to. The critical aspects that have been identified are contact localisation, handling missed calls and voicemail, creating forwarding rules and transferring calls.

Aside from those, some less critical aspects where improvements might be desirable include making the messaging function more visible to users, better presentation and grouping of settings, more flexible functionality around favourite contacts and lists, and more distinguishable buttons throughout several sections of the interface.

9. Requirements elicitation

With the most critical issues regarding the user interaction identified, the process of formulating those issues into requirements to be used during redesigns of the interface commenced. The purpose of the requirements presented in this chapter is to aid in further development of the existing application, rather than serving as base for a completely new one. As such, these requirements do not constitute an exhaustive list for creating similar apps, but rather assume the app exists in its form as per the usability testing described in the previous chapter.

The requirements described here reflect somewhat different abstraction levels (Bligård, 2011, pp. 55-68), and could in some instances fall on the border between requirements and guidelines. This reflects how the identified issues are deemed to require different amounts of further development, and might thus be considered to be at different stages of the development process. As so some requirements are more specific and measurable, whereas others are less so.

The requirements were elicited using the five whys method, as described by Pojasek (2000), to search for the root cause of the problem. As the root cause often led to concepts specific to the existing application, some requirements violate Bligård's (2011, pp. 55 – 56) views that requirements should not be solution specific. As the goal of the evaluation was to find areas of improvement for the existing solutions, this was likely unavoidable.

9.1 Mobile client

The mobile version of the Mi-application has been the subject of the most thorough evaluation, and has thus generated the most related requirements. Those are described and motivated below, categorised by which general area of the interaction they relate to.

9.1.1 Contacts

1. *A user should without effort be able to use a search function to find any contact.* Without effort in this sense means that they should not have to navigate through different categories in order to use the search function successfully. A user who decides the search function will be most convenient most likely know the name of the contact, and should not also need to state which category the contact belongs to.
2. *A user should be able to view all contacts in a single list.* Finding a contact should not require a user to know which category the contact belongs to.
3. *A user should be able to filter contacts by different categories.* If the user does know which category the contact belongs to, this function should be available. This can be useful if the user has several contacts with the same or similar names, and thus needs to separate them.
4. *Filtering contacts by category should be a choice and not default.* Categorisation should not be a necessary step for finding contacts, regardless of the manner in which the user goes about finding the contact.
5. *The difference between different categories of contacts should be easy for users to interpret.* With six different categories of contacts, distinguishing one from the other must be easily done. Particularly the category called “Other” gives

little clues as to which contacts fall under that category

6. *There should be a clear distinction between information and manoeuvrability on the contact card.* As several users expressed confusion over what different elements on the contact card meant, a distinction between for example viewing a phone number and calling it should be present.

9.1.2 Favourites

1. *Users should be able to add contacts to favourite lists directly from the list screen.* Most test subjects expressed they preferred this way of adding contacts to lists, which seems to coincide better with the users' mental model of favourite lists.
2. *The button for "Favourite Lists" should be as large or larger than the other visual elements on the same screen.* Several users struggled to find this button, and making it a more significant visual element will help users identify it more easily.

9.1.3 Messages

1. *The message function should be visible from the home screen.* While most users managed to send a message efficiently, the function is hidden in the hierarchy. As several users stated that they used an app for sending internal instant messages at their work place, there seems to be a demand for this functionality. Filling this demand could significantly improve the value users receive from the application, and that depends on users being aware of it. Accessing messages through each contact also contradicts how native message handling occurs in mobile phones.
2. *The text field for entering messages in the Android version should be clearly distinguished from the background.* As this issue was exclusive to Android users, the solution present in the iOS version of the application is obviously advantageous.
3. *Sent and received messages should be grouped together by date received, and provide more distinction between name of sender and the message itself.* A wish expressed by several users, and which corresponds better to how messages are handled in native messaging functions.

9.1.4 Forwarding

1. *The multitude of operations should be grouped together, so that users discover them in the appropriate order.* As many users failed to find the "Rest of the Day" button until after the time had been set, better arrangement should improve the performance score. As the users rated the task as rather easy, yet still performed with poor efficiency, it is reasonable to assume the problem lies with identifying the operations quickly, rather than identifying the purpose of the operations.
2. *Buttons for quick forwarding should express their functionality clearly.* As several users did not identify this function, it needs to be distinguished more clearly

3. *The user must be made aware of whether or not group calls are received during an active forwarding rule.* Currently users are only made aware of the relationship between forwarding rules and group calls when placing a quick forwarding rule, and not in a way that most users understand.

9.1.5 Transferring calls

1. *The application should support the users when switching from the native call screen to the Mi application.* As this is where most users expressed uncertainty and required assistance, supporting this step is vital to enhance the users' experience of the application.

9.1.6 Settings

1. *All settings should be managed from the same menu/screen.* As the division of settings was stated as illogical by most users, and there is no clear need to keep the settings separate, they should all be available from the same screen.
2. *Settings should be grouped according to what functionality they relate to.*

9.1.7 Missed calls

1. *Upon returning to the phone after a missed call, the user should be made aware of the missed call whether the Mi application is open or not.* This corresponds to how normal phones indicate missed calls, and should thus coincide with users' mental model.
2. *Upon discovering a missed call, the interface should guide the user to information about who called and what happened to the call.* Many users stated that they normally called back upon finding a missed call. If the caller was directed somewhere else, or left a message with details about their reason for calling, calling back immediately might be unnecessary, unproductive or even be considered annoying by the caller.

9.1.8 Voicemail

1. *Voicemail should be reachable by the user both as a contact and when viewing a call which led to a voicemail.* This is where most users searched for a way to reach voicemail. This would also allow users to decide in which order to listen to voicemails, have they received more than one, by accessing it in connection with the call that led to the voicemail.
2. *Getting voicemails sent to an e-mail address should be optional.* Users' opinions differed on the matter of voicemail via e-mail. While some stated that it was practical (and indeed all users who successfully managed to listen to their voicemail did so via e-mail), many felt that they already got too many e-mails.

9.2 PC-client

While the evaluation of the PC-client was non-empirical and less thorough than that of the mobile application, a number of requirements could be elicited from the result. Those requirements are displayed below.

9.2.1 Transferring calls

1. *Pressing the button which says “Transfer call” during an ongoing call should allow the user to actually transfer the call, regardless of whether it is transferred directly or by connecting two ongoing calls.* As the button clearly states that it should be used to transfer calls, most users will likely press it to do so. Thus it is of great importance that the application actually supports this path of action.
2. *The user must receive a clue that clicking a contact's number actually transfers the call to them.* This is how calls are currently transferred directly, and the interface must support this. This requirement should also be combined with the previous, in order to make the process of transferring calls as intuitive as possible.

9.2.2 Forwarding

1. *The forwarding functionality must be presented in the main window, not under a menu.* Hiding the forwarding functionality in the hierarchy is unnecessary as there is plenty of space to display it in the main window. This will also reduce the IPA of creating forwarding rules.

9.2.3 Messages

1. *The messaging function should be displayed in the main window of the application.* As with the mobile application, the messaging functionality is hidden within the hierarchy, and will thus likely be underutilised.

10. Concept development

With requirements and guidelines determined, the creative process of finding solutions to the identified issues commenced. While some issues were fairly narrow and the solution for them rather straight forward, such as the absence of a notification for missed calls, some required a more iterative ideation process. Below is described firstly how ideas for solutions were generated, and subsequently how they were combined and translated into graphical concepts.

10.1 Functionality analysis

The ideation process was roughly divided into two parts. The first part consisted in translating the identified issues and specified requirements into functionality. This was mainly done by answering questions of the following nature:

- Which existing functions relate to the requirement?
- How will the requirement affect the existing functionality?
- Will the requirements create a need for extended functionality?
- Will the requirement create a need for entirely new functionality?
- How is the requirement addressed in competing products (including immediate competitors to Advoco as well as the mobile phones' native functionality)?

The result of the first round of ideation I described below, grouped in the same way as the requirements in the previous chapter. It should be noted that eliciting requirements and translating them into functionality was done simultaneously and iteratively, and thus this section very much restates what was described in the previous chapter, although with a more solution oriented focus.

10.1.1 Contacts

The main issue surrounding contacts related to finding external contacts, as several users had severe difficulty with this task. Additionally, some confusion arose over the many different numbers presented on the contact cards of colleagues. This narrows the functionality to be addressed to finding contacts and the presentation of contact information. As the most immediate competition to the Mi applications in the context of finding external contact is the phone's native phone-book, this can be seen both as a target (making it as easy or easier to use the application than the native phone functionality) and looked to for inspiration.

Finding contacts can be broken down further into the different functions that may allow a user to find a contact, i.e. searching, scrolling, and categorisation of contacts. These functions, as well as the presentation of contacts information are thus the most important to address in the context of contacts.

10.1.2 Favourites

The creation of new favourite lists was mainly affected by the operation of actually pressing the button to create a new list (Figure 12). As this element is rather small compared to others, the main solution should revolve around making it more noticeable.

Once a list was created, most users managed to add a contact to it without much effort. Most did, however, express frustration over not being able to do it directly from the

newly created list. Adding the functionality of adding contacts directly from lists should therefore be prioritised in the context of favourite contacts.



Figure 12: Small button to create new Favourite list

10.1.3 Messages

With most users performing very well in regards to sending and viewing messages, the main area for improvement remains to make the functionality more visible in the interface. This thus relates to improving the functionality of presenting functionality. Additionally, formatting and grouping of the messages are other areas where improvements may be made to existing functionality.

When looking at competing applications for messages, such as Whatsapp (WhatsApp, 2015) and Facebook Messenger (Facebook Messenger, 2015), some additional functionality might be considered, perhaps most prominently so the possibility for group messages. While a wish for group messaging was not explicitly expressed during the tests, such functionality exists in many messaging applications, and the addition of it to the Mi applications should therefore be considered.

Considering the main competition to the messaging function is dedicated messaging applications, such applications should be considered important inspiration and input during concept generation.

10.1.4 Forwarding

While most users felt confident in creating forwarding rules, the efficiency was left

wanting. The unnecessary amount of clicks suggests that information and functionality was not presented in a perspicuous manner. The functionality to be addressed in order to satisfy the requirements is thus the presentation of information and operations surrounding forwarding rules.

This holds true regarding the functionality of quick-forwarding rules as well, as several users failed to recognise the buttons on the home screen with which such rules were created (Figure 13).



Figure 13: Unclear functionality of buttons

An additional note is that some of Advoco's competitors offer functionality to direct calls to different recipients depending on the caller. While the Mi application does not have such functionality, and it has thus not been evaluated, it is easy to imagine situations in which it could be desired. An example could be to forward customers to a colleague and children to a spouse.

10.1.5 Transferring calls

With the main issue surrounding the transfer of calls lying outside the actual application (in the switch between the native call screen and the Mi application), this requirement most likely requires entirely new functionality to be added. Such functionality should handle or support the transition between the call screen and the Mi application.

10.1.6 Settings

With requirements on settings focused on accessing all settings from the same menu, the functionality to be addressed naturally becomes the presentation of the available functions. Additionally, the grouping of said functions should also be considered.

10.1.7 Missed calls

With the tasks of discovering and identifying missed calls being large contributors to the total difficulty rating during the tests, the lack of functionality to indicate missed calls is one of the most prominent issues identified. Adding functionality similar to that of the native mobile phone functionality, or the message notification currently present in the Mi application (Figure 14) is therefore an important step towards improving the usability of the application. As such functionality exists throughout many other applications, the focus should be mainly on implementing solutions found in similar applications, rather than inventing entirely new ones.



Figure 14: Indication of new message

10.1.8 Voicemail

Finding voicemail was judged as impossible or almost impossible by most users, and only one in ten actually managed to listen to their voicemail. Thus there is a clear lack of functionality surrounding making the user aware that voicemail exist at all, and that they have received a new one. The current solution, dependant on e-mail, should also be overlooked, as several users did not have e-mail synchronisation on their phone, or expressed reluctance towards receiving more e-mails than they already did.

10.2 Concept generation

To develop concepts from the ideas around requirements and functionality a focus group was held, with the main intent to brainstorm (and brainwrite) around the implementation or alteration of functionality. The session lasted for around one hour,

with five participants. Printed images of the current interface were used as mediating objects, and the participants used sketches and verbal information to communicate their ideas.

The focus group was complemented by reviewing applications with functionality similar to Mi's. Such applications included immediate competitors (from which the main source of input was user manuals publicly available), native functionality in mobile phones as well as other applications with communication as a main function.

The resulting ideas are presented below, categorised in the same way as in the previous chapters.

10.2.1 Contacts

A main opinion during this second ideation session was that the division between categories of contacts is largely unnecessary. A user should be able to search and scroll through all contacts available, regardless if the contacts are internal, external, groups or other. The division should, however, be available should the user wish to only display for instance internal contacts, but this should not be the default case.

Further, the many options for viewing certain categories of contacts give the phone screen a cluttered impression, and makes it difficult to overview. Instead the interface should focus on what the user will actually most likely need, such as a clear search function and a clear listing of contacts in alphabetical order. Displaying the most recent contacts could also be a good feature, as these are often the ones a user needs to access quickly.

10.2.2 Favourites

Surrounding favourites the solutions were deemed fairly straightforward: Increasing the visibility of the “add new favourite list” button and adding a function to add contacts directly via the list interface. Borrowing functionality from a native Android contact handling function (to add recipients to messages), this latter functionality could be made as simple as adding a button for “add contacts to list” and then clicking checkboxes in a contact list.

As for the button to add a new favourite list, this could likely be changed to more resemble the button for creating new forwarding rules, as users managed to find this with more ease during the tests.

10.2.3 Messages

To make the messaging function more visible an icon for messages should be placed in the main navigation menu. This correlates well with how messages appear natively in mobile phones (as a function separated from the contacts), and would thus better coincide with the users' mental models than the current representation model. This would also solve the issue of the messaging function being buried in the hierarchy.

Implementing this would mean altering the process of creating a message. The current pattern, as illustrated below in Figure 15, should be replaced by the pattern illustrated in Figure 16:



Figure 15: Current schematic

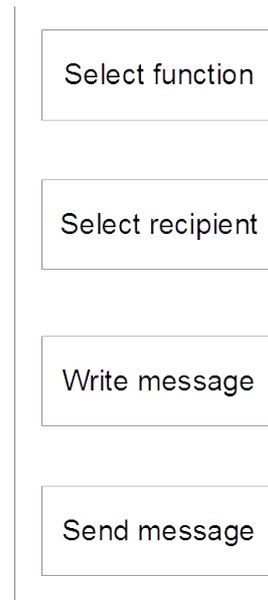


Figure 16: Suggestion for new schematic

Adding group message functionality would further complicate implementation, but would also increase the value to the end user and allow the message function to better compete with applications such as Whatsapp and Facebook Messenger.

10.2.4 Forwarding

With the main issue being the users' ability to overview the information and operations displayed on the forwarding screen (Figure 17), the functionality of presenting said information could be changed insofar that it appears stepwise rather than all at once. While this might affect the IPA negatively, adding clicks to go from one step to another, the final performance of the users might be improved.

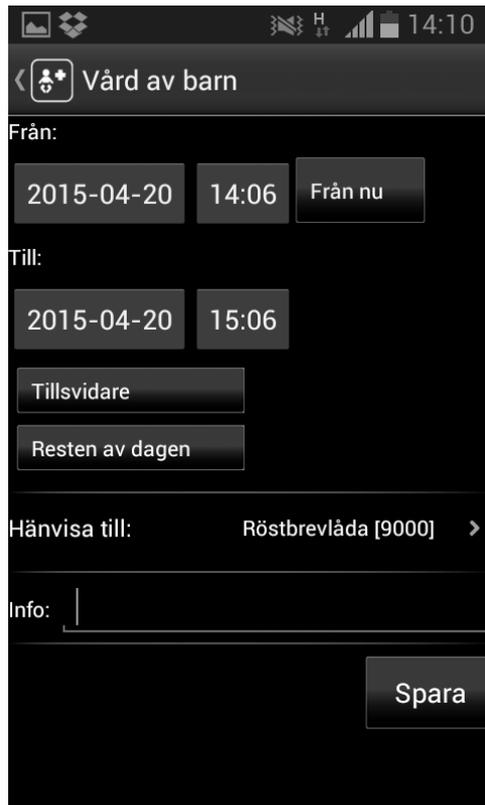


Figure 17: A plethora of elements

10.2.5 Transferring calls

Supporting the user while transitioning from the mobile phone's native call screen and the Mi application would require additional functionality to be added to the application. Providing such support could be done by a few distinct categories of functionality. Providing support through a user manual is what direct competitors to Advoco are doing, and has the benefit of being very easily implemented, while relying on the users to actually read the manual.

The other types of functionality include providing information directly on the native phone screen, providing a function or operation to switch to the Mi application on the native phone screen, or automatically transitioning the user to the Mi application upon an incoming call via the PBX.

Which type of functionality to utilise depends mainly on the aspects of implementation difficulty, and the extent to which the functionality actually fulfils the requirement of supporting the user.

10.2.6 Settings

The requirements placed on settings provide a rather straightforward approach to implementing changes in the interface. Combining all settings under the same menu, and creating a grouping similar to the existent, although more extensive, would alter the functionality of displaying settings in the desired way. An important aspect is that such grouping should be founded in the functionality the settings affect, rather than the inner

workings of the application (see chapter 3.3). Using a single settings menu and grouping is also how most applications and mobile operating systems work, further enhancing the effect of the users' mental models.

Implementing a “Save” button where it is missing is even more directly implementable, and requires little further explanation.

10.2.7 Missed calls

While the users struggled to find missed calls within the Mi application, most users did find the call in the phones native interface. While this might reduce the negative effects for the user, it will likely turn users away from using the Mi application to return the call. This means the user will not achieve the positive effects of providing their customers or other external contacts with a work associated phone number.

For example, when external callers dial the “normal” mobile phone number, the call will not pass through the PBX, and the user will not be able to transfer the call. Further, the functionality of call groups diminishes if the outgoing number is the user's personal mobile phone number. The external caller might also be confused or frustrated by having to save more than one phone number.

Thus, adding functionality to make the users aware of missed calls via the Mi application is an important step to encourage users to rely completely on the application for their work related telephony needs. Such functionality is common throughout several different types of applications, and inspiration and input should thus be taken from such applications, rather than inventing completely new functionality.

10.2.8 Voicemail

While the use of voicemail varies amongst users, with some finding it convenient and others adamantly refusing to use it, the functionality exists and should thus be implemented in a user friendly manner. The main issue was the absence of functionality to reach voicemail via the application, save for calling the predetermined number 9000 or possibly calling the auto attendant and directing oneself. Thus, new functionality needs to be implemented to aid users in discovering and listening to their voicemail.

Such functionality should emerge from the fact that all voicemails are the result of a missed call. Thus, finding a voicemail should be an extension of discovering and identifying a missed call, and the functionality should be placed accordingly.

11. Final concept

In this section, the process of converting the ideas around functionality in the previous chapter into graphical concepts will be described, along with the results. Due to the limited timespan, only very limited iterations were made, and not all functionality is depicted in the images.

Most images are based on the Android version of the application, but where the iOS version differs significantly both will be presented. Otherwise it can be assumed the iOS version will appear as similar as possible.

11.1 Home screen

In order to facilitate several of the new concepts, some alterations had to be made to the home screen. The new concept is shown below in Figure 18 and 19, with the Android version to the left and iOS version to the right. The main differences is the addition of a messaging icon in the bottom menu, a new design of the buttons to create quick forwarding rules and the removal of the extra settings button, as the two settings menus should be packed together as one.

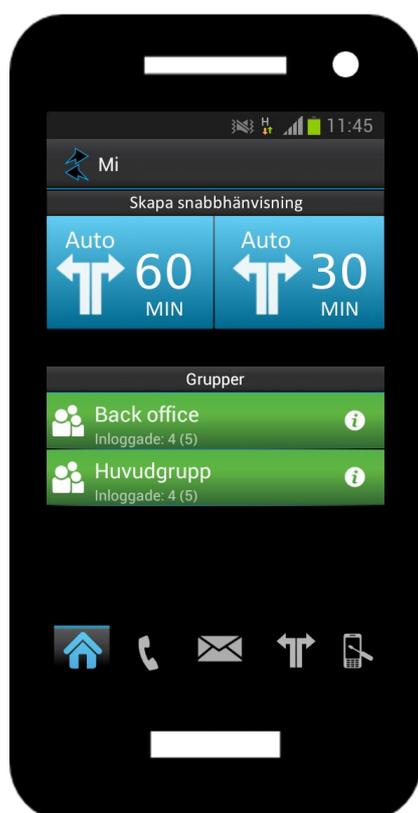


Figure 18: Home screen Android

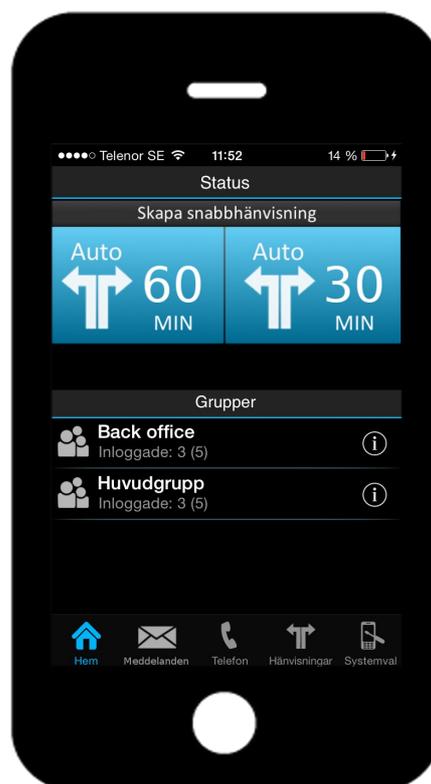


Figure 19: Home screen iOS

11.2 Messages

To make the messaging function more visible, an icon has been added to the bottom navigation menu (visible in for example Figure 18 and 19). Clicking this button takes the user to a screen where ongoing conversations are displayed, along with an option to start a new conversation. Starting a new conversation takes the user to a new screen, where the recipient is chosen. Finally the user ends up at the normal screen to enter a message.

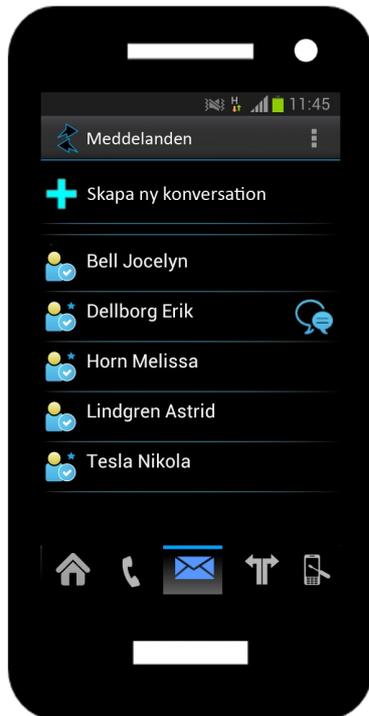


Figure 20: Overview of conversations

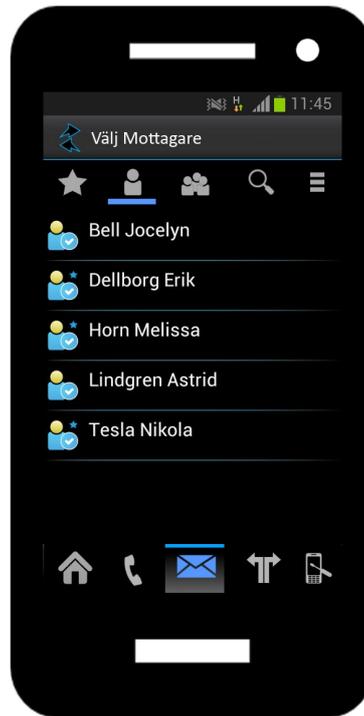


Figure 21: Selecting a recipient

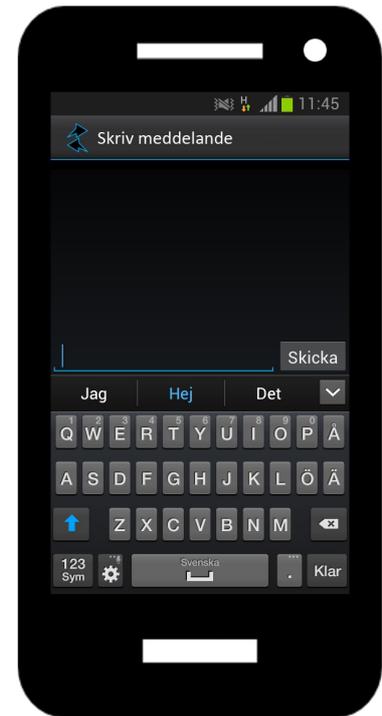


Figure 22: Writing the message

While displaying the messaging functionality more prominently, this flow of creating messages is much more similar to normal messaging services than the current solution, and should thus coincide better with the users' mental models. Once a conversation has commenced, the screen is displayed below (Figure 23). The changes are focused on making the text field for entering messages more prominent, and displaying the messages sent and received in a clearer way, borrowed from the messaging functionality of the PC-client.

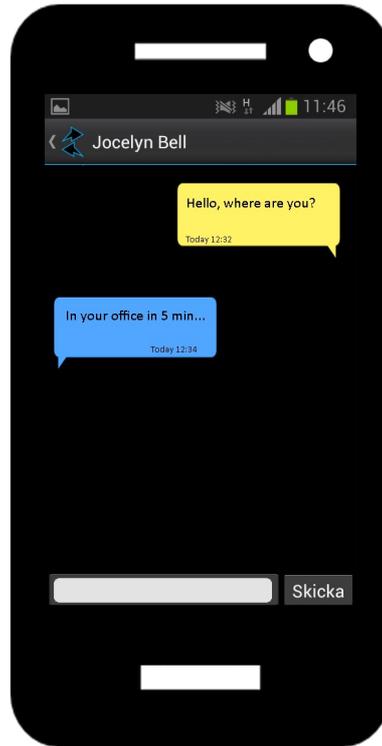


Figure 23: New conversation formatting

It should be noted, that as the problem with finding the text field was limited to Android users, this change is likely not necessary to implement on the iOS version of the application.

11.3 Forwarding Rules

The first screen has not been changed much, aside from emphasising the button for creating a new forwarding rule. While few users struggled to find this button, some uttered that they would like it to be more distinguished. The consistency throughout the application is also improved, as the button to add a new forwarding rule is the same as for creating a new conversation in the messaging functionality (see above), and for creating a new favourite list. The second screen, where a reason for the forwarding rule is selected remains unchanged. The two screens are displayed below (Figure 24 and 25).

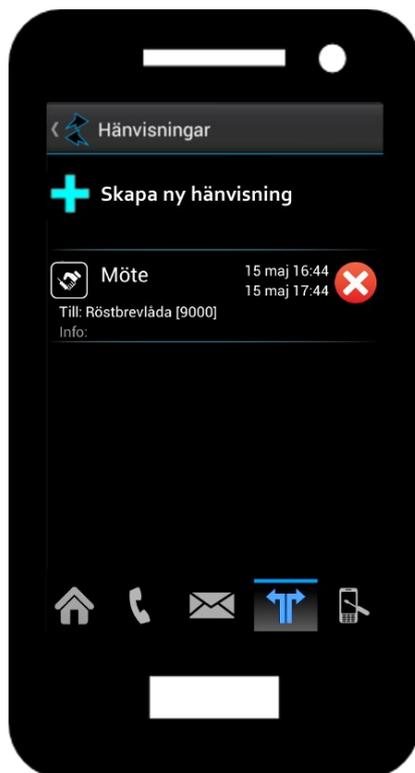


Figure 24: Creating new forwarding rule

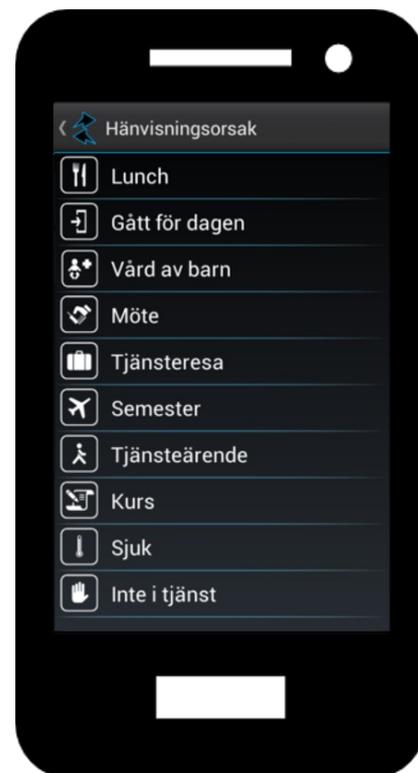
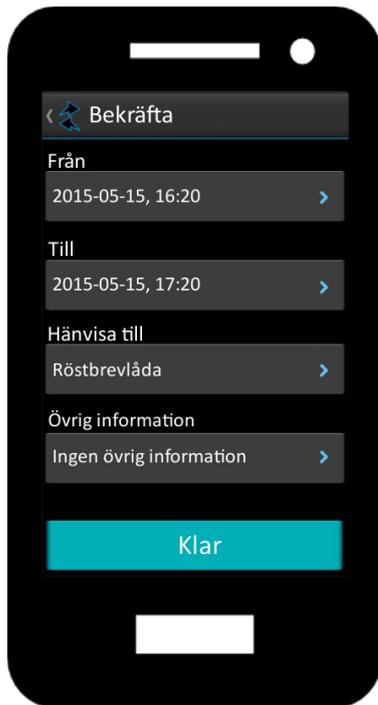


Figure 25: Selecting a forwarding cause

Once the user has passed through the first two screen, a screen similar to the original screen displays the options for setting a start time, an end time, a place where to direct incoming calls, and an option to add additional information. The main change (aside from layout changes) is that the shortcuts to set the times are instead presented once the user clicks the button to change a time. This takes them to a screen where the time may be set, or a shortcut utilised. These three screens are displayed below.



*Figure 26:
New overview screen for
forwarding rules*



*Figure 27:
Setting start time*



*Figure 28:
Setting end time*

As the default starting time is set as “now”, the need for a “From now” button may be discussed. If the user does not want to start the forwarding rule immediately, it is reasonable to assume the most common case will be to start it at a whole clock stroke, or at half an hour past. It would then be reasonable to keep the “From now” button, and set the default time to the next whole or half hour, as displayed above. The final two screens, for setting the place to forward calls to and other information, are not altered.

As some of Advoco's competitors offer functionality to direct calls differently depending on the caller, implementing such functionality might, however, be considered. In such a case, the screen for setting the forwarding place might be changed into the screen presented in Figure 29 below. As this functionality has not been subjected to evaluation, it should, however, not be implemented without ensuring it is desirable. Thus, it should not be considered as a part of the solution concept, but rather a visualisation of an idea for implementing new functionality.

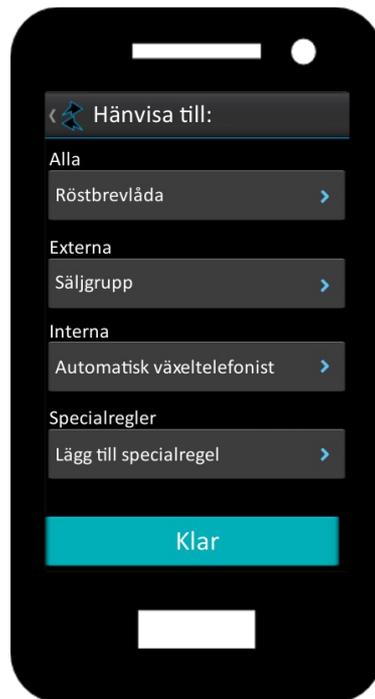


Figure 29: Optional screen to direct calls to different places

This screen offers the user the possibility to set customised rules for external contacts, internal contacts, and to set specific rules for individual contacts or groups. It could also be used to exclude some contacts from the forwarding rule all together, allowing some contacts to call through. An example of when a user might want to use such rules is if they are expecting an important call, but does not want to be reachable by anyone else. Another use could be to let internal contacts go to voicemail, but send external callers to an available colleague, ensuring no customer hang up rather than leaving a voicemail.

11.4 Transferring Calls

After discussing with Advoco (Advoco, 2015, B), it was deemed unsuitable to configure the application to completely replace the native dialer on the users' phones, mainly since this required the users to do so themselves. As many users might prefer not to, in order to keep a clear distinction between their work and personal life, this solution would only help a select number of the users.

While it is not possible to alter the actual native call screen on a user's mobile phone, some applications utilise floating windows to place elements on top of other applications, remaining visible regardless of which screen the user is viewing. An example is the Facebook Messenger application, which displays chat heads (Facebook Messenger, 2015, and Gizmodo, 2015) when someone writes a message to the user.

If such functionality could be implemented, the application could display something similar to the third image from the left below (Figure 30), once the application has identified that the call is in fact received via the PBX, and thus possible to transfer. Upon clicking on the button to transfer the call (image three from the left), the user is

presented with the current screen for transferring calls (rightmost image), from which most users managed to complete the task without effort.



Figure 30: Making use of chat head principle to guide users to the Mi application

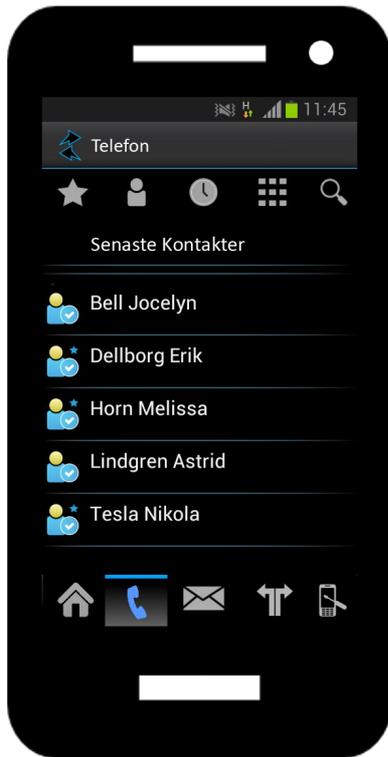
As the step identified as most critical and problematic to the users was the transfer from the native call screen to the Mi application, implementing this concept could likely greatly enhance the usability for this particular task. It is, however, important to consider the placement of the button, as it must not cover any buttons on the native screen.

11.5 Finding Contacts

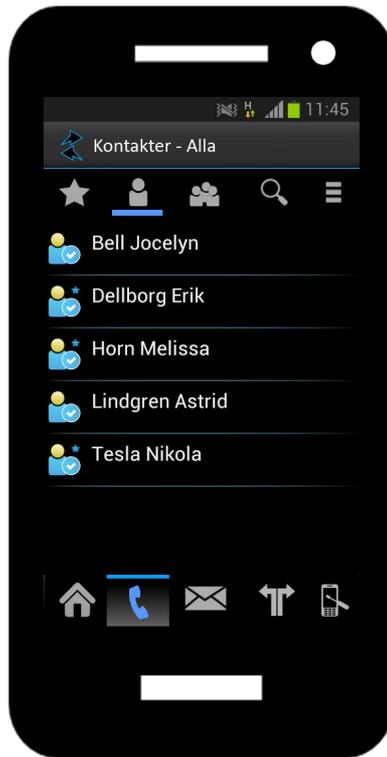
Calling an external contact was found to be a significantly difficult and inefficient task for many users. As the option of calling external contacts without using the Mi application at all is near at hand for the user, this functionality was in high need of improvement, to ensure the users do not turn away from the Mi application. The requirements were focused much around the concepts of categorisation of contacts and the visibility of the search function. The solution to those issues is displayed in the three figures below (Figure 31, 32 and 33).

When the user clicks the phone icon in the bottom menu, the leftmost screen appears. This displays the most recently used contact, as well as a menu at the top. The menu icons will lead the user to, from left to right, favourite contacts, a contacts screen (middle image), the call log, a numeric dialer, and the search function. If the search button is pressed, the user's keyboard appears with a text field on top. Other than the contact button, the buttons behave as in the current application.

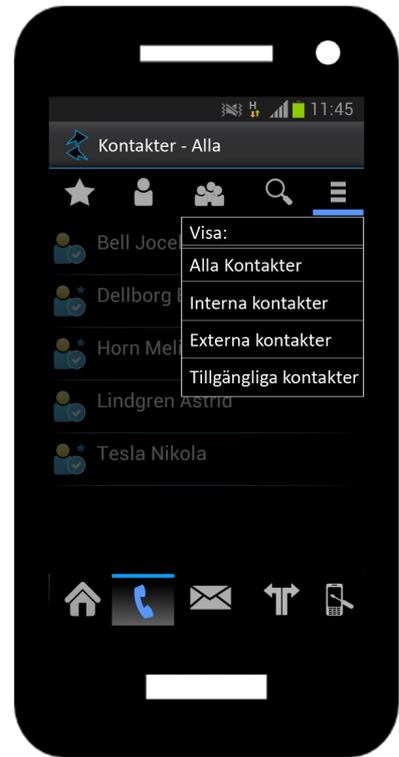
Once the contact button has been clicked, the user is presented with the middle screen, listing all the user's contacts without categorisation. The icons in the top menu change, and lets the user choose, from left to right, favourite contacts, all contacts (default), call groups, the search function, and a menu with filters. The filters work much like the applications current categorisation of contacts, in limiting which contacts are displayed. While the current categorisations may be used as filters, a more thorough evaluation of which filters are most useful should be conducted before implementation.



*Figure 31:
Telephone screen*



*Figure 32:
Contacts screen*



*Figure 33:
Filtering contacts*

The filters are chosen from the menu displayed on the rightmost screen.

Once a contact has been chosen, their contact card is displayed, as seen in Figure 34. While mostly the same as the current contact card, symbols have been added to indicate where call and messaging functions are available.



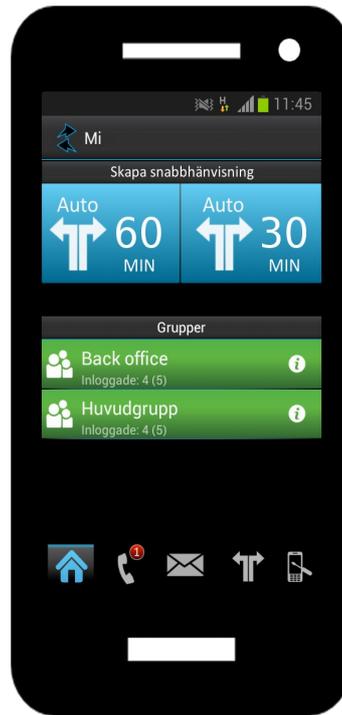
Figure 34: Contact card

11.6 Missed calls and voicemail

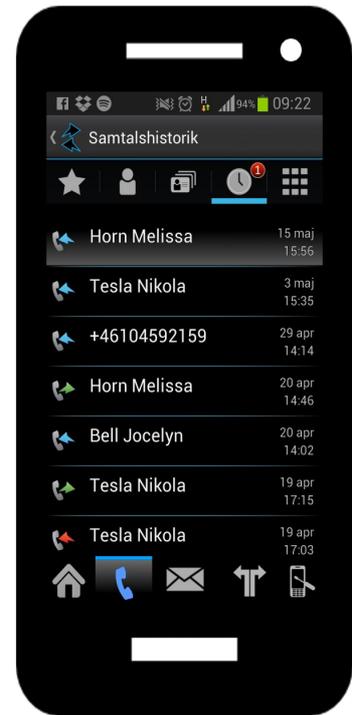
To make the user more aware of a missed call, the icon on the phone's native screen has been modified to indicate that something new has happened (Figure 35). This is complemented by implementing similar functionality to that which currently exists for displaying a new message (Figure 36). Once the user clicks on the phone icon, the call log is displayed with the missed call highlighted (Figure 37).



*Figure 35:
Indication of missed call*



*Figure 36:
Further guide to missed call*



*Figure 37:
Missed call highlighted*



Figure 38: Button for listening to voicemail

Once the call is clicked, the normal screen for displaying a call is presented, with the addition of an indication if the caller has left a voicemail (Figure 38). Clicking this lets the user listen to the voicemail related to the missed call. Should the user want to check their voicemail without going through a missed call, voicemail is present as a properly named internal contact.

11.7 Further development suggestions

In this section, a number of issues not addressed by the graphical concepts in the earlier sections are presented. Several issues were such in nature that graphical representations did not serve a significant purpose, or were very similar in appearance and principle to other solutions, and thus a verbal description was used.

11.7.1 Adding a new favourite list

The current button for adding a new favourite list (Figure 12) should be replaced by one of the same appearance as the new button for adding forwarding rules or creating a new message conversation (see Figure 24 and Figure 20 respectively). Keeping buttons with similar functions consistent throughout the interface is beneficial in letting users find the functions more easily. Making it a significant visual element on the screen further facilitates this.

11.7.2 Adding contacts directly from favourite lists

As many users described this would be their preferable course of action, this should be supported. As with adding a new favourite list (see above paragraph), a button for adding new contacts should mimic the ones found in other places in the interface. To help the users add several people to a list at once, a suitable solution would be to add checkboxes next to the contact, where the users could mark which contacts they desired.

11.7.3 Call groups and forwarding rules

Most users expected that a forwarding rule would mean no calls came through, and thus the default setting should be that a forwarding rule logged the user out of all groups. All but a few users stated they expected to be automatically logged in once the rule expired (when they chose to log out of all groups during a quick forward rule), and thus this should also be the case. The rule of thumb should be that during forwarding rules no calls reach the user unless otherwise stated, and once a rule expires, everything goes back to how it was before.

11.7.4 Settings

One of the tasks with the lowest performance score involved changing a setting in a menu separate from the previously used settings menu. Thus both settings menus should be merged into one, preferably the one accessible from the bottom menu in Android (named “system tuning”). With many settings under the same menu, the settings should be properly grouped according to what functionality they affect. A suitable grouping suggestion could be:

- Incoming calls – All settings that affect how incoming calls are handled or forked.
- Outgoing calls – All settings that affect how outgoing calls are initiated and which number is presented
- Forwarding rules – All settings that affect forwarding rules and quick forwarding rules
- Contacts – All setting that affect how contacts are displayed and sorted
- Advanced settings – All settings that may require advanced knowledge of the application, or that can affect the applications ability to function normally, for example logging out.
- Other – A single group for settings that do not fit in anywhere else. Possibly a suitable location for the setting for receiving voicemails by e-mail.

Additionally, an option to restore all settings to a default value should be available.

11.8 PC-client

While the evaluation of the PC-client was non-empirical and less extensive than that of the mobile application, some issues were identified. The requirements elicited from those issues are addressed here, not as graphical concepts but rather like development suggestions.

11.8.1 Transferring calls

The current solution supports the user well when the task is to connect two ongoing

calls (of which one is parked). While this way of transferring calls may sometimes be preferable (i.e. checking with the recipient before transferring the call), direct transfer should also be supported. This should be done by letting the user click the button marked “transfer call”, and then showing the user where to click next to transfer the call. A solution for the latter step would be to show buttons on each contact marked “Transfer to”.

11.8.2 Forwarding

The main issue with forwarding was that the function was only accessible via the menu, rather than from the main window. Adding a button with the forwarding symbol from the mobile application, along with an appropriate text would remove the problem users might have in realising the function is available.

11.8.3 Messages

As with the messaging function in the mobile application, the PC client hides the function under each contact. To encourage users to utilise this function, a button with the icon from the mobile application should be present in the main window. In terms of functionality, the same structure as proposed for the mobile client should be implemented, allowing the users to create conversations similar to those of most messaging applications.

12. Concept evaluation

In this chapter, the concepts presented in chapter 11 are evaluated. The first evaluation consists in an ECW of the new concepts, and the second evaluation looks to how well the concepts address the requirements specification.

12.1 ECW of new concepts

To evaluate the new concepts, an ECW was performed, based on the tasks listed below. The selection of tasks was done based on the weighting of the tasks from the usability tests.

- Call an external contact
- Send an instant message
- Create a forwarding rule
- Transfer a call
- Identify a missed call
- Listen to voicemail

The complete set of ECWs is found in Appendix VIII. The following main conclusions could be drawn for each task respectively.

12.1.1 Call an external contact

Most likely the user will look for contacts under the phone screen, as few if any users struggled with this step during the usability test. Once there, the potential issue would be identifying which symbol in the menu to click. While it is possible some users might not find the correct icon on the first try, there are fewer possibilities and a more distinct difference between the icons than in the current design.

Further, should a user want to use a search function, they will almost certainly find it, as it is placed amongst all other icons. If the user is not expecting a search function to be present, they might still miss it, but they are much more likely to find it in the top menu than in the heading bar where it is currently located.

If the user has entered the contacts screen, they are guaranteed to notice the list of contacts. Either by scrolling or by using the search function, they will certainly find the contact, albeit with varying efficiency. Experienced users might utilise the filtering option to increase the efficiency, if there is a multitude of similar contacts.

Once the contact card has been opened, the user will most likely immediately identify the phone icon and successfully place a call.

12.1.2 Send an instant message

The most considerable improvement consist in the user being aware that a messaging function exist as soon as the home screen is opened. From there no real issues in the interaction were identified.

12.1.3 Create a forwarding rule

With only four elements visible on the main forwarding screen (Figure 26), the user

will likely be aware of all the functions available. Once the user clicks on any of the buttons, the corresponding functionality is easy to grasp. A possible issue might be that the user is unsure of which time the button for “rest of the day” will assign. Should they try it, however, the dials immediately change in a way that the user cannot miss.

12.1.4 Transfer a call

Should the functionality be properly implemented, the issue of transitioning to the Mi application is significantly alleviated. The user might still feel uncertain as to what happens to the call when they press the button, but if their intention is to transfer the call this uncertainty should be minute.

Once the button has been pressed the user will likely perform as was observed in the usability test, during which few problems arose once the user had opened the Mi application.

12.1.5 Identify a missed call

The added clues provide a direct trail for the user to follow to the missed call, similar to how the user would find a new message. As finding a new message was the task which was performed with the highest average efficiency, it is unlikely the users will encounter problems when identifying a missed call.

12.1.6 Listen to voicemail

Once the user has reached a missed call they are very likely to quickly be aware of whether the call led to a voicemail. It is also highly unlikely they will not find the button which to click in order to listen to the voicemail.

Should the user want to listen to their voicemail without the presence of a missed call, it is reasonable to assume they will try to find a related contact. This assumption is based on the observation that many users did so during the usability testing, and that this is how voicemail is typically accessed from a mobile phone.

12.2 Requirements fulfilment

In this chapter, the requirements specified in chapter 9 are compared to the concepts in chapter 11. The purpose of the comparison is to determine whether or not the concepts address the requirements for each of the identified improvement areas (chapter 9). As many of the requirements lack a specified measurement, fulfilment cannot be determined, but the evaluation is more focused on whether the concepts will constitute an improvement over the current design.

Table 4 Below lists each requirement, along with which concept it has been addressed by. Comments on how well the requirement has been addressed are also listed where applicable.

Requirement	Addressed in chapter:	Comments
Contacts		
A user should without effort be able to use search function to find any contact	11,5	
A user should be able to view all contacts in a single list	11,5	
A user should be able to filter contacts by different categories	11,5	
Filtering contacts should be a choice and not default	11,5	
The difference between different categories of contacts should be easy for users to interpret	Not fully addressed	Confusion may remain
There should be a clear distinction between information and functionality on the contact card	11,5	
Favourites		
Users should be able to add contacts to favourite lists directly from the list screen	11.1.7	
The button “Favourite lists” should be as large or larger than the other visual elements on the same screen	11.1.7	
Messages		
The message function should be visible from the home screen	11,1	
The text field for entering messages in the Android version should be clearly distinguished from the background	11,2	
Sent and received messages should be grouped together by date received, and provide more distinctions between name of sender and the message itself	11,2	

Forwarding

- The multitude of operations should be grouped together so that users discover them in an appropriate order 11,3
- Buttons for quick forwarding should express their functionality clearly 11,1
- The user must be made aware of whether or not group calls are received during an active forwarding rule 11.7.3

Transferring calls

- The application should guide the users when switching from the native call screen to the Mi application, by providing visual cues 11,4

Settings

- All settings should be managed from the same menu or screen 11.7.4
- Settings should be grouped according to what functionality they relate to 11.7.4

Missed calls

- Upon returning to the phone after a missed call, the user should be made aware of the missed call whether the Mi application is open or not 11,6
- Upon discovering a missed call, the interface should guide the user to information about who called and what happened to the call 11,6

Voicemail

- Voicemail should be reachable by the user both as a contact and when viewing a call 11,6

Getting voicemails sent to an e- 11.7.4
mail address should be optional

PC-client

Transferring calls

Pressing the button which says 11.8.1
“Transfer call” during an
ongoing call should allow the
user to actually transfer the call,
regardless of whether it is
transferred directly or by
connecting two ongoing calls

The user must receive a clue 11.8.1
that clicking a contact's number
actually transfers the call to
them

Forwarding

The forwarding functionality 11.8.2
must be presented in the main
window, not under a menu.

Messages

The messaging function should 11.8.3
be displayed in the main
window of the application.

Table 4: Requirement fulfilment

13. Discussion

In this chapter the procedure and result of the project are discussed. First, the result is discussed in relation to the purpose and goal of the project, and subsequently the methods are discussed in terms of how they were altered, and what circumstances affected the outcome. The discussion is mainly grouped by the main parts of the project, but as the earliest work had influence over the outcome of the latest, some overlap occurs.

13.1 Results discussion

This section focuses mainly on reflections regarding the outcome of the project, how this corresponds to the initial goals, and what conclusions may be drawn. Other reflections on the result can serve as a guide for usage of the results in subsequent development projects at Advoco.

13.1.1 Evaluation findings

The evaluation result revealed several issues in the users' interaction with the application's interface, as has been described in previous chapters in this report. One of the key insights is that in several aspects of the functionality, the main competition to the application is simply the users' native mobile phone applications. This was particularly significant in the tasks surrounding contact handling, as some experienced users stated that they simply did not use the application for this purpose, as it was easier to perform the task without the application.

While there is a positive aspect of this, in that even if the application fails the users can still accomplish their tasks, there is also a clear downside. Much of the functionality requires calls to come in via the PBX, which in turns require external callers to have the user's work phone number stored. For example, forwarding rules do not work on calls which are made directly to the user's mobile phone number.

Thus it becomes obvious, that perhaps the most important aspects of the application are in fact the ones where the user does not have to use the application, as this will greatly affect the total benefit the user may gain from using the application.

Perhaps the most severe problems occurred during the tasks related to identifying missed calls and voicemail. While the lack of cues inside the Mi application was rather straightforward, another aspect might hold more complexity. Several problems occurred not due to the Mi applications user interface, but rather due to the applications interface with the mobile phones native functionality.

As such, further evaluations should be conducted regarding how well the application interacts with the operating system, in terms of notifications, and synchronising call logs and contacts. The optimal solution would likely be to allow the application to “disconnect” the native functionality when calls come in via the PBX, but as this may be impossible, other solutions should be investigated.

Aside from these findings, the performance and difficulty scores derived from the baseline part of the evaluation should be mentioned, most importantly so the performance score, as this requires some discussion around future comparisons. Since the score is calculated using the IPA of the current design, this must be kept in mind for future comparisons. As the equivalent of the IPA for the difficulty score is simply one and will not change, future comparisons between difficulty scores are not an issue.

If a future evaluation is conducted (as it should be), two alternatives arise. Either, the performance score is calculated using the new design's IPA, or the score is calculated using the current designs IPA. The latter alternative has the advantage that the results are immediately comparable, as the score will simply show how much more (or less) efficient the users accomplish the tasks, regardless if it stems from higher intuitiveness or a shortened IPA (or both). The downside is that no comparisons can be made should new functionality be introduced.

The former alternative above has the disadvantage of entangling the differences in the IPA of any compared concepts within the comparison. In principle, a new concept with significantly lower IPAs could receive a worse performance score than an old one, even if the users needed fewer clicks to complete the tasks. In such a situation, both the fact that the new interface actually does perform better, and that it seems to severely lack in intuitiveness, should be conveyed. This could be achieved by complementing the performance score (calculated with the new IPA) with a comparative score of the respective IPAs, for example by dividing the old IPA with the new. In this way, while the performance score could be slightly worse for the new concept, the IPA is significantly better, and when factored in shows that the performance has in fact increased. The example below illustrates the procedure.

Old IPA: 5

New IPA: 3

Old performance score: 0.5 (giving a 10 click average)

New performance score: 0.4 (giving a 7.5 click average)

New performance score with IPA ratio factored in: $0.4 * (5/3) = 0.67$

It should be noted that the performance score (PS) in this example should not be confused with the total performance score from the analysis (TS). With this in mind, Advoco should have a useful tool for ensuring the user experience of their products continue to improve. As the methodology used during the evaluation was successful in identifying interaction problems, it should also serve as a basis for Advoco when conducting further evaluations (although with some considerations, discussed under future recommendations below). Thus the secondary purpose and goal of the project have been fulfilled.

13.1.2 Final concepts

The final concepts address most of the identified issues, but one requirement which was not fully addressed was that of clarifying the difference between contact categories. The main issue here seemed to stem from the discrepancy between the users' mental models of contact storage and the represented model. While the users most likely knew what the word 'colleagues' means, it is not common for mobile phone books to use this type of categorisation. Thus it should be further investigated if the best approach to this requirement would be to change the phrasing of the categories, or to change the represented model completely, to more closely resemble the users' mental models.

Regarding the forwarding functionality of the new concepts, some interesting aspects could be mentioned. While the performance score for the current design was quite poor, the difficulty rating suggested that the users found the task to be rather easy to perform. This discrepancy was the basis for the conclusions that the users expected the task to be more difficult, and that the performance was reduced because they failed in performing operations, rather than identifying functions. Thus the focus of the concept was to

facilitate the interaction on an operational level, and leave the functionality as it was. A future evaluation could determine if the conclusions were in fact correct.

In terms of goal fulfilment the concepts should, based on the non-empirical evaluation, enhance the users' experience of the Mi application, by reducing the amount of interaction issues. This should help Advoco appeal more to their customers, fulfilling the primary purpose and goal of the project. As for the impact goal defined in the early stage of the project, this should also be fulfilled (by the same argument), provided users actually place value on an enhanced User Experience. To thoroughly verify that users do value the new concepts higher, they would of course have to be implemented and tested further.

13.2 Procedure discussion

In this section of the discussion, the procedure of the project will be discussed, in terms of how the various methods were altered to suit the projects, how this might have affected the outcome, and which other factors had significant effects on the result.

13.2.1 Impact mapping

The main modification made to the method of impact mapping was to group users by to what end they would presumably use the application, rather than for example which type of company they worked at, age groups, or demographic data. While this categorisation had the benefit of facilitating the formulation of clearly defined user goals, it also had drawbacks. A significant drawback is that it lacks some support for targeting specific customers in the evaluation, as a single customer might fall into more than one category.

As such, it might be more difficult to formulate a strategy in which a particular customer group is targeted, and directing the improvement efforts to suit those particular customers. However, if a user seems to benefit from more than one category of functionality Advoco has to offer, then any improvement to either category will increase the value the user receives. This effect is even more enhanced if the user falls into all three categories, with the added benefit that the application is in nature very well adapted to that user's needs in terms of functionality.

Perhaps the most significant drawback from this alteration of the method, however, is that the grouping of users does not take into account as much of the individual users' contexts and characteristics. This means that the evaluation results cannot be connected to specific user traits in the same way as had the grouping instead been based on more user specific traits, such as profession, type of business, age, experience with smartphones, or similar.

For future evaluations, Advoco should consider redefining the user groups to better capture the more specific use contexts, as this could expose potential correlation between user traits and usability issues. This could in turn help better explain the underlying cause for the issues, and thus help further improve the interaction. It could also help in differentiating the user selection, which in turn could give more perspectives on the interaction, which is further discussed below in section 13.2.2.1.

Should a refined user categorisation be performed, it is important to acknowledge that the evaluation will be more specific to narrowed user groups, and will suit more specific impact goals than those employed in this project.

Thus it can be stated that the categorisation used in this project is better suited for

addressing a wide selection of users than targeting particular ones.

13.2.2 Usability test

Constituting a major part of the project, the Usability tests formed the basis for the subsequent concept development. As such, it can be seen as the most important part of the project, and its different parts are discussed in the sections below.

13.2.2.1 Users

Due to the limited time available for the usability tests, the selection of users was not optimal. More users from older age groups could likely have yielded more extensive results, particularly around the area of text and symbol size, as impaired vision is more common in older people.

Additionally, all experienced users had used the application for at least six months. Having user with a more limited experience of the application could possibly have given more insight as to the nature of the learning curve.

A related insight was that not all experienced users performed notably better than users who were completely unfamiliar with the application. Based on this, along with the limited time available, the decision was made not to conduct further tests with experienced users, but that the interface should in fact fully support inexperienced users in order to support all users. While this prioritisation aimed at targeting broader problems that affected all users, it came at the cost of investigating issues relating to experienced user performance (EUP).

While this decision mainly had the consequence that the baseline evaluation should be based on inexperienced users (as prolonged use does not necessarily increase efficiency significantly), it is likely that more varied qualitative data could have been gathered had more experienced users taken the test. Conducting tests with users from all the defined user groups would most likely have given more distinct perspectives on the application, and could have linked certain trends in the qualitative data more closely to the user goals. In future evaluations, this is something that Advoco should consider.

Connecting trends in both qualitative and quantitative data to the user goals would add another dimension to the analysis, and provide more detailed explanations of the underlying causes of interaction issues. As discussed in section 13.2.1, finding more specific traits and goals for the users would provide more specific information regarding their interaction, and could thus provide more targeted solutions. More targeted solutions could, however, be less generalisable, and not apply to other user groups.

13.2.2.2 Test procedure

During the test efforts were made to ensure the circumstances were as similar as possible for all participants. One main deviation from this was that some new users and all experienced users used a borrowed phone rather than their own, whereas most new users installed the application on their own device. For existing users, borrowed phones were used to avoid affecting settings and such on the users' own applications, and to be able to connect the user to the same PBX as the test leader without having to log in and out of the application (which is rather time consuming). The new users who used a borrowed phone did so either because they did not want to install the application on their own device or encountered technical problems during the installation.

In retrospect it might have been better to simply let all users use a borrowed phone, but as the initial intention was to let all users use their own device (and only use the borrowed device as a back-up) in order to eliminate the effects of an unfamiliar device, this was not the case. Having all users use a borrowed device would have eliminated any variance in performance and experience between users with their own or borrowed devices. This should be considered, should Advoco want to perform further tests.

While the application is identical between devices with the same operating system, using an unfamiliar phone might still have affected the users' behaviour. One factor could be the screen size, as the borrowed devices had relatively small screens compared to many other devices, particularly the borrowed Android device. This might have had an effect on how well the users could perceive visual elements in the interface. Additionally, the experience of having the application on one's own device is likely slightly different than that of an unfamiliar device, in terms of what emotional connection the user might have to their own phone, and the meaning they ascribe to the device.

While investigating the effect of borrowed versus own devices fell outside the scope of this project, conducting such an evaluation could provide additional input as to how to interpret the results of this project.

Whether borrowed devices are user or not, the application does not exist alone in the device used during the test. Interruptions such as incoming e-mails, text messages, and notifications, may affect the behaviour of the users significantly. During the test, some users were in fact so focused on the application, that they did not notice the indication of a missed call from their phone's native notification functionality. This might have generated a higher difficulty rating than had the users used the phone in a non-test situation. Thus efforts should be made to minimize such effects in future evaluations.

While the users were instructed not to feel like they were the ones being evaluated, and that they should not feel embarrassed about asking for help or making errors, the test circumstances can never perfectly match those of a real use situation. Factors such as stress, tiredness, or nervousness about contacting an unknown colleague or talking to an important customer are difficult to recreate, but can likely change the user's experience quite significantly. Complementing the usability test with observations in real use situations could thus likely provide even more accurate and extensive information.

13.2.3 Analysis of usability test

Using a subjective rating scale to determine the difficulty for each tasks provides both benefits and drawbacks. Since the scale is subjective in nature, even though the ends of the scale were set to be as objective in nature as possible, there will most certainly be some discrepancies between what two users consider a to be a certain value. Thus comparison between users is not as straightforward as with the more objective click-counting.

The subjective does, however, provide the benefit of revealing discrepancies between the experienced difficulty of the task and the efficiency (or lack thereof). This was the case for the task of creating a forwarding rule, which received a quite poor performance score but a quite low difficulty rating. One explanation could be that many users were expecting this task to be rather complicated, and thus found it easier than they had thought, even though they did not perform perfectly.

This indicates that expectation of difficulty might play a role in the user experience for this type of application, and adding a measurement of expectation to an evaluation

could provide interesting input. While there is no reason not to improve tasks that are expected to be difficult as much as possible, it is of utmost importance to adequately support tasks that are expected to be easy. The situation of high expected difficulty and high actual difficulty is likely less harmful to the user experience, than low expected difficulty and high actual difficulty, as the latter might leave the user feeling incapable.

13.2.4 Requirements

The requirements listed in this project fall short in some aspects of what Bligård (2011, pp. 55-57) defines as requirements. Most prominently, many requirements are quite solution specific, and some lack measurability. The first shortcoming is the consequence of the fact that the goal was a re-design rather than a new design, and should thus utilise as much as possible of current design solutions.

The lack of measurability stems from the fact that fulfilment of some requirements is subjective in nature rather than objective. An example could be the requirement that the buttons for quick forwarding should express their purpose clearly. Where one user might consider this requirement fulfilled, another might not do so. This could be addressed by assigning it a quantifiable metric, for example that 90% of all users should rate it as “clearly expresses its purpose”, but as such evaluation would require extensive user input (beyond the scope of this project), and the numbers risk being arbitrarily chosen, it was instead decided to evaluate if the new concepts fulfilled the requirements better than the old design.

Most of the requirements without measurability relates to user behaviour, for instance the requirement “*Upon returning to the phone after a missed call, the user should be made aware of the missed call whether the Mi application is open or not*”. A potential measurement for this requirement could be that a certain percentage of users should notice the missed call in a certain amount of time.

Quantification of the percentage and time in question should, however, be done through an investigation into which levels are desirable, and should be based on an evaluation designed for such a purpose. An appropriate starting point could be to investigate for each task at which time, or at which amount of clicks, the user starts getting frustrated. Evaluating user expectations (as discussed in chapter 13.2.3) could be another starting point.

13.2.5 Concept development

The concept development took place in two steps, the first of which served to highlight which functionality a requirement might put demands on, and the second how this functionality could be implemented or altered. The purpose of this division was to ensure the solutions built to the farthest extend possible on the existing functionality, as the goal was a re-design rather than a completely new design.

Naturally this way of working limited the possible solution (as this was the intention), and most likely a concept generation process less bound to the existing product could have yielded even more advantageous designs. Such designs would, however, be far more difficult to implement, and would require several iterations of a formative evaluation to ensure the solutions supported the users properly. Thus it fell outside the scope of this project.

13.2.6 Concept evaluation

Due to limited time and difficulties in preliminary implementation, only a non-empirical evaluation of the developed concepts was conducted. An evaluation thorough

enough to yield results with which a comparison to the previously conducted usability evaluation would have been meaningful was beyond the scope of this project. Should, however, the decision be made to implement some or all of the proposed concepts, such an evaluation would be highly recommended, to ensure the end quality of the product.

An evaluation such as the one described in the previous paragraph would mainly serve a summative purpose, in order to ensure the concepts actually fulfilled the requirements and constituted an improvement over the current design. During an implementation process, a continuous process of formative evaluation should thus be conducted as well, to maximise the positive effects of the new concepts.

13.3 Future recommendations

In the future development of the Mi application, a number of recommendations for Advoco may be made, based on the outcome of this project.

A first recommendation is to perform recurring formative evaluations during the product development process. Such evaluations should always start by defining which user goals the affected functionality will relate to, which can be properly done through impact mapping. Such evaluations should also include creating meaningful tasks for test procedures, as well as defining meaningful metrics. Much of what has been presented in this report could (and should) naturally be re-used in such a case, but as circumstances in the products environment change, it is also important to update the foundations of the evaluation, to avoid lock-in effects.

Secondly, summative evaluations should be performed regularly, to ensure any re-designs serve their intended purpose and move in the direction of Advoco's long term goals. The methodology used in this project could serve as a good starting point for defining metrics and compilation of data, as well as requirement elicitation.

In terms of the evaluation procedure, the methods used in this project have been largely successful in terms of identifying issues in the interaction. It is, however, recommended that Advoco seek to target a wider variety of users during their evaluations, as this can provide further, valuable insights. Particular attention should be directed towards finding users from all user groups, in order to even further facilitate a connection between the qualitative data and the user goals.

When conducting the tests, it is also recommended to apply consistency in whether a borrowed device or the user's own device is used, in order to eliminate the effects of this variable. Performing a series of tests with borrowed devices and another series with the users' own devices could give further input into interpreting the results, if the effect of the device can thus be determined.

Finally, Advoco should aspire to incorporate their users as much as possible into all their product development efforts, as this is the key to creating successful and profitable products.

14. Conclusions

In this chapter the main conclusions that can be drawn around the result of the project are presented.

From the impact mapping can be concluded that Advoco's users can be categorised by what main benefits they can receive from using the Mi application. This facilitates connecting user goals to Advoco's short and long term goals of enhancing the user experience of their product to become the preferred telephone switch provider, which is what should be endeavoured throughout the development process. The user groups defined in this project are:

- Users who mainly benefit from providing an increased availability to their customers
- Users who mainly benefit from more efficient communication with their customers
- Users who mainly benefit from more efficient communication within the workplace

The evaluation of the Mi application revealed several areas of potential improvements of the user experience. A recurring issue was that the application's representation model differed from the likely mental model of the user's, particularly concerning the handling of missed calls, and messages. A final conclusion is that while several interaction problems were identified, large parts of the Mi application's interface provided good support for users. With the exception of listening to voicemail, very few users failed to perform any of the critical tasks.

While all identifies issues could serve as potential areas for improvements, some were decidedly more critical to address. To receive the maximum benefit the application has to offer, for instance providing customers with a single phone number and making effective use of forwarding rules, the user should rely on the application for all their work related phone usage. Thus, issues where the phone's native applications can provide the same functionality are particularly critical to address.

Some of the most critical identified issues regarded:

- Inefficient navigation amongst contacts. This was resolved by allowing the users to access all contacts in a single list, as well as emphasising the search function, and extending it to reach not only the active tab. Furthermore, the contact card was altered, to clarify which elements displayed information and which allowed actions.
- A lack of functionality for identifying missed calls and voicemails. To solve this issue notifications about missed call both inside the application and on the icon for the phone's native screen were added, complemented by guiding the user to the missed call and voicemail. Adding voicemail as a contact should further alleviate issues surrounding accessing this.
- A lack of support for transitioning from the mobile phone's native call screen to the application, for transferring ongoing calls. The addition of visual cues for transitioning to the application during an ongoing call should help the users feel more secure during the transition, and thus enhance their experience of transferring calls.

- Poorly displayed messaging functionality, leading to users not using it. This should be resolved by displaying the messaging functionality in the main navigation menu, thus encouraging users to utilise it, and being more consistent with their mental models. Additionally, formatting the messages more in line with other messaging applications should further enhance the user experience.
- Performance issues regarding forwarding rules. The new design of the forwarding screen should serve to make the users more aware of the operations needed to utilise the functionality, thus reducing the performance issue.

As the new concepts should improve several aspects of the interaction with the Mi application, the primary purpose and goal of the project should be considered successfully fulfilled, although future evaluations of implemented changes are needed to confirm this conclusion.

15. References

- Albert et al.: Albert, B., Tullis, T. and Tedesco, D., Beyond the Usability Lab. Conducting Large-scale Online User Experience Studies, 2010
- Auerbach & Silverstein: Auerbach, C. F. and Silverstein, L. B., Qualitative Data, and introduction to coding and analysis, 2003
- Bergman & Klefsjö: Bergman, B., Klefsjö, B., Quality, from Customer Needs to Customer Satisfaction, 2010
- Bligård: Bligård, L-O., Utvecklingsprocessen ur ett Människa-Maskinperspektiv, 2011
- Bligård, L-O. and Osvalder, A., 2013, Enhanced Cognitive Walkthrough: Development of the Cognitive Walkthrough Method to Better Predict, Identify, and Present Usability Problems, Advances in Human-Computer Interaction, ,
- Cooper et al.: Cooper, A., Reimann, R., Cronin, D., Noessel, C., Csizmadi, J. and LeMoine, D., About Face, the Essentials of Interaction Design, 2014
- Desmet, P., Hekkert, P., 2007, Framework of product experience, International Journal of Design, ,
- Jordan, 1998: Jordan, Patrick W, An Introduction to Usability, 1998
- Lallemant, Carine, Gronier, Guillaume and Koenig, Vincent, 2015, User experience: A concept without consensus? Exploring practitioners' perspectives through an international survey, Computers in Human Behavior, , 35-48
- Nielsen & Landauer: Nielsen, J. and Landauer, T.K., A mathematical model of the finding of usability problems, 1993
- Osvalder & Ulfvengren: Osvalder, A-L., Ulfvengren, P., Information och interaktion i tekniska system, 2011
- Ottersten and Balic: Ottersten, I. and Balic, M., Effektstyrning av IT. Nyttan uppstår i användningen, 2010
- Pojasek, R. B., 2000, Asking "Why?" five times, Environmental Quality Management, , 79 - 84
- Rook, L, 2013, Mental models: A robust definition., The Learning Organization, , 38-47
- Tullis & Albert: Tullis, T., Albert, B., Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics, 2013
- Vidulich & Tsang: Vidulich, M. A. and Tsang, P.S., Mental Workload and Situation Awareness, 2012

15.1 Online sources

Facebook messenger; *Messenger*, <https://www.messenger.com/features>, viewed 2015-05-10

Gizmodo; *What are facebook chatheads*, <http://gizmodo.com/5993646/what-are-facebook-chat-heads>, viewed 2015-05-10

WhatsApp; *Whatsapp*, <https://www.whatsapp.com/>, viewed 2015-05-10

15.2 Verbal sources

Alvenby, Sofia; Product Manager, Advoco AB, Stockholm. 2015. Recurring correspondence from January to June 2015.

Advoco AB (A); Start up meeting 2015, Advoco AB, Stockholm. January 20, 2015.

Advoco AB (B); Half time presentation 2015, Advoco AB, Stockholm. April 21, 2015.

Appendixes

Appendix I

Hierarchical Task Analysis of Mi application



Appendix II – Enhanced Cognitive Walkthrough (ECW) of Mi mobile application

In the following tables, a number of abbreviations are used for display purposes. They are explained below:

- Rt = Rating, answer to the question in the leftmost column. 5 = very likely, 1 = Very unlikely
- Cat = Category, a categorisation of any potential usability issues, as defined by Bligård & Osvalder, 2013.

Function: Call contact

Function: Call Contact	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	User will assume function exists under Phone button	-	-
Will the interface give clues showing that the function is available?	5	Yes, phone icon signals this	-	-
Will the user associate the right clue with the desired function?	5	Yes, the user will connect calling a contact with the Phone Icon	-	-
Will the user associate the function with the right elements?	5	Yes, no other elements indicate relation to calling contacts	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, a contact will have been called	-	-

Function: Open Contact Card	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Having contacts under the Phone button is common in mobile devices	-	-
Will the interface give clues showing that the function is available?	5	Yes, the Phone Icon	-	-
Will the user associate the right clue with the desired function?	4	User might think Contacts can be accessed through a separate button	Some users might (though not likely) look for contacts somewhere else	T
Will the user associate the function with the right elements?	5	Yes, no other icons indicate relation with contacts	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, the Contact Card will be opened	-	-

Function: Choose Selection	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Yes, the user will assume selections are made under Contacts	-	-
Will the interface give clues showing that the function is available?	5	Yes, clear symbols	-	-
Will the user associate the right clue with the desired function?	3	Users might not realise different symbols are related to selections	Dividing contacts into different categories by default (without option not to) is uncommon in mobile phones	-

Will the user associate the function with the right elements?	2	Some elements are clear, some are not, and they differ in appearance (tabs under colleagues)	Users might not realise what the different categories mean, such as Other, External...	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, other contacts will be displayed	-	-

Function: Choose Colleagues Selection	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Yes, the user sees that options are available in the top menu	-	-
Will the interface give clues showing that the function is available?	5	Yes, Icons are displayed	-	-
Will the user associate the right clue with the desired function?	3	Users might be unfamiliar with only being able to display one category of contacts at a time	This categorisation is not common in Phone-books	T
Will the user associate the function with the right elements?	3	User might not know which icon corresponds to which category	Icons do not clearly express their purpose	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, Screen will change	-	-

Function: Search for Contact	Rt	Story	Problem	Cat
Will the user know where the function is available?	2	The function is difficult to see, especially on Android Devices, and only works for active screen	The symbol does not appear where all other symbols are located on the screen. Additionally, it is not clear that only the active tab is being searched.	H
Will the interface give clues showing that the function is available?	4	Yes, the magnifying glass icon, yet in the wrong place	User will expect all related symbols are grouped together	T
Will the user associate the right clue with the desired function?	4	If they spot the symbol, they will likely link it to searching	Not all users might spot it	H
Will the user associate the function with the right elements?	5	Yes, no other icons indicate relation with contacts	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, matching contacts will be displayed	-	-

Operation: Press Phone Icon	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to make a call	-	-
Will the user notice that the correct action is available?	5	Yes, the icon is clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	Yes, phone icon is strongly connected to making calls	-	-
Will the user be able to perform the action without effort?	5	Yes, this requires little effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the screen will change	-	-

Operation: Click Favourites	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, if the user knows the Contact is a Favourite	-	-
Will the user notice that the correct action is available?	5	Yes, the symbol is clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	Yes, clicking the button displays favourites	-	-
Will the user be able to perform the action without effort?	5	Yes, requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, screen will change	-	-

Operation: Press Colleagues	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	2	Unclear what difference is to the previous Colleagues tab	Users will not know the difference between this and previously pressed button (on Android)	U
Will the user notice that the correct action is available?	3	Unclear that the text is clickable	Text does not signal that the user may click it	T
Will the user associate the correct action with the desired effect?	5	If the user knows the meaning of the tab, they will	-	-
Will the user be able to perform the action without effort?	4	Text is small and requires precision to press	Some users might struggle to click text	H
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Screen will change	-	-

Operation: Press External Contacts	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, if the user knows the contact is an External contact	-	-
Will the user notice that the correct action is available?	5	Yes, button clearly visible	-	-
Will the user associate the correct action with the desired effect?	3	Only if they know what it means (Android)	Button (Android) only has a symbol, which does not clearly indicate External contacts. IOS button also has text	T
Will the user be able to perform the action without effort?	5	Requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, External contacts will be displayed	-	-

Operation: Press Search button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	If the user expects to find a search unction they will	-	-
Will the user notice that the correct action is available?	2	Only if they know it is there	Button is placed away from the other opertions, and on Android very poorly displayed	-
Will the user associate the correct action with the desired effect?	5	If they spot the magnifying glass icon, they will likely connect it to the search function	-	-
Will the user be able to perform the action without effort?	5	Yes, not difficult if the button is spotted	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, text field and keyboard will appear	-	-

Operation: Enter text	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, this is as textfields always work	-	-
Will the user notice that the correct action is available?	5	Yes, keybord will appear	-	-
Will the user associate the correct action with the desired effect?	5	Yes, user knows how to enter text (Domain knowledge)	-	-
Will the user be able to perform the action without effort?	5	Yes, user can write text	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, matching contacts will be displayed	-	-

Operation: Press Contact	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to select a contact	-	-
Will the user notice that the correct action is available?	5	Yes, contacts are clearly displayed	-	-
Will the user associate the correct action with the desired effect?	5	Yes, user will know pressing a contact selects them (domain knowledge)	-	-
Will the user be able to perform the action without effort?	5	Requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, contact card will open	-	-

Operation: Press Connection	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user will try to make a call	-	-
Will the user notice that the correct action is available?	5	Yes, connections displayed clearly	-	-
Will the user associate the correct action with the desired effect?	3	User might not know that pressing a connection calls that number, nor the difference between connections	Difference between connections not expressed clearly. No indication of functionality, success depends on user's knowledge	-
Will the user be able to perform the action without effort?	5	Requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, a call will be initiated	-	-

Function: Transfer call

Function: Transfer Call	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Yes, user will assume a call must be ongoing to transfer it	-	-
Will the interface give clues showing that the function is available?	3	Only when the application is opened	User might not know how to transition to application	U
Will the user associate the right clue with the desired function?	5	Once the application is opened, it is obvious	-	-
Will the user associate the function with the right elements?	5	-	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Call has been transferred (Message box on iOS)	-	-

Function: Open Mi application	Rt	Story	Problem	Cat
Will the user know where the function is available?	3	Depends on how well the user knows their own phone	Not all users might know how to transition from call screen (native) to another application	U
Will the interface give clues showing that the function is available?	-	Happens outside of application	No clues given	-
Will the user associate the right clue with the desired function?	-	-	-	-
Will the user associate the function with the right elements?	-	-	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Mi application will be opened	-	-

Function: Select Recipient	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Yes, user will be sent to Phone Screen	-	-
Will the interface give clues showing that the function is available?	5	Yes, contacts will be displayed	-	-
Will the user associate the right clue with the desired function?	5	Yes, the user wants to select a recipient	-	-
Will the user associate the function with the right elements?	5	Yes, no other elements indicate relation	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, call will have been transferred	-	-

Operation: Press Transfer Button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to transfer a call	-	-
Will the user notice that the correct action is available?	5	Yes, big button	-	-
Will the user associate the correct action with the desired effect?	5	Button states and expresses its purpose	-	-
Will the user be able to perform the action without effort?	5	No effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Screen will change	-	-

Operation: Press Connection	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to transfer call	-	-
Will the user notice that the correct action is available?	5	Button clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	-	-	-
Will the user be able to perform the action without effort?	5	No effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Call will be transferred	-	-

Function: Place forwarding rule

Function:Place Forwarding rule	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Yes, domain knowledge after introduction	-	-
Will the interface give clues showing that the function is available?	5	Yes, symbols and buttons	-	-
Will the user associate the right clue with the desired function?	4	Users might not know what the forwarding symbol means, nor what the quick forwarding buttons do	Symbol and buttons do not clearly express their purpose. Text on iOS helps	-
Will the user associate the function with the right elements?	5	No other elements indicate forwarding	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, a new forwarding rule will be displayed	-	-

Function: Quick Forward	Rt	Story	Problem	Cat
Will the user know where the function is available?	4	Only if they have been told	Buttons not obvious	T
Will the interface give clues showing that the function is available?	5	Big buttons	-	-
Will the user associate the right clue with the desired function?	4	Only if they know from before	Buttons have no symbols or text	T
Will the user associate the function with the right elements?	4	User might think it is done on the Forwarding screen	Similar functionality available in two places	T
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, Home-screen will show new rule	-	-

Function: Create regular Forwarding rule	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Domain knowledge after introduction	-	-
Will the interface give clues showing that the function is available?	5	Symbol in button menu	-	-
Will the user associate the right clue with the desired function?	4	Only if they know from earlier	Symbol does not express functionality. Text on iOS helps	T
Will the user associate the function with the right elements?	5	No other elements express relation to forwarding	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	New rule will be displayed on Forwarding screen	-	-

Function: Configure rule	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Once the user has gotten this far it is obvious	-	-
Will the interface give clues showing that the function is available?	5	User is taken directly to appropriate screens	-	-
Will the user associate the right clue with the desired function?	5	User is guided through the process	-	-
Will the user associate the function with the right elements?	5	No other elements express relation to this	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Rule will be displayed	-	-

Function: Set From-time	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Yes, the user will be guided to the appropriate screen	-	-
Will the interface give clues showing that the function is available?	5	Yes, a time will be displayed	-	-
Will the user associate the right clue with the desired function?	5	Yes, text will hep user	-	-
Will the user associate the function with the right elements?	5	Yes, no other elements indicate From-time	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, time will have changed	-	-

Function: Set To-time	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Yes, the user will be guided to the appropriate screen	-	-
Will the interface give clues showing that the function is available?	5	Yes, a time will be displayed	-	-
Will the user associate the right clue with the desired function?	5	Yes, text will hep user	-	-
Will the user associate the function with the right elements?	5	Yes, no other elements indicate From-time	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, time will have changed	-	-

Operation: Press Quick Forward button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to add a forwarding rule	-	-
Will the user notice that the correct action is available?	5	Buttons are large	-	-
Will the user associate the correct action with the desired effect?	4	Only if they have been previously told	Buttons have no text or symbols	T
Will the user be able to perform the action without effort?	5	Requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	They will see the next step	-	-

Operation: Confirm to exit call groups	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	3	User might not know what the relationship between callgroups and forwarding rules look like	Relation is not clearly expressed	T
Will the user notice that the correct action is available?	5	Buttons are clearly visible	-	-
Will the user associate the correct action with the desired effect?	3	See first question	-	-
Will the user be able to perform the action without effort?	5	Requires little effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, screen will display the active rule	-	-

Operation: Press Forwarding button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to add a new forwarding rule	-	-
Will the user notice that the correct action is available?	5	Button clearly visible	-	-
Will the user associate the correct action with the desired effect?	4	New users might not recognise symbol	Symbol does not express functionality. Text on iOS helps	T
Will the user be able to perform the action without effort?	5	No effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Screen will change	-	-

Operation: Press Add new rule button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to add a new rule	-	-
Will the user notice that the correct action is available?	4	Some users might struggle to find it	Button is not where users will expect it	T
Will the user associate the correct action with the desired effect?	5	Yes, once they spot the button	-	-
Will the user be able to perform the action without effort?	4	Requires precision	Small button	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Screen will change	-	-

Operation: Select Reason	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	User has no other choice	-	-
Will the user notice that the correct action is available?	5	-	-	-
Will the user associate the correct action with the desired effect?	5	-	-	-
Will the user be able to perform the action without effort?	4	Many different choices	Users might need time to find the appropriate Reason	T
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Screen will change	-	-

Operation: Set Date	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	User wants to set a time	-	-
Will the user notice that the correct action is available?	4	iOS text does not indicate it may be clicked	-	T
Will the user associate the correct action with the desired effect?	5	Clicking the date will change the date	-	-
Will the user be able to perform the action without effort?	4	Precision needed	Small button	T
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Date will have changed	-	-

Operation: Set Time	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	User wants to set a time	-	-
Will the user notice that the correct action is available?	4	iOS text does not indicate it may be clicked	-	T
Will the user associate the correct action with the desired effect?	5	Clicking the time will change the time	-	-
Will the user be able to perform the action without effort?	4	Precision needed	Small button	T
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Time will have changed	-	-

Operation: Press Shortcut	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	4	Only if they are aware of the shortcut	User might not see all shortcuts immediately	U
Will the user notice that the correct action is available?	5	Button are clearly visible	-	-
Will the user associate the correct action with the desired effect?	4	Some shortcuts are not obvious	Rest of the Day does not say which time it will set	-
Will the user be able to perform the action without effort?	5	No effort needed	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, time and date will change	-	-

Operation: Press Save	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to save their rule	-	-
Will the user notice that the correct action is available?	5	Button clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	Yes, button states its purpose	-	-
Will the user be able to perform the action without effort?	5	No effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Rule will be displayed	-	-

Function: Send internal message

Function: Send Internal Message	Rt	Story	Problem	Cat
Will the user know where the function is available?	2	Users will only find function under contact crds	Function hidden in the hierarchy	H
Will the interface give clues showing that the function is available?	3	Only on the contact card	Functionality not displayed	H
Will the user associate the right clue with the desired function?	5	Once the clue is found, it is clear	-	-
Will the user associate the function with the right elements?	5	No other elements indicate messaging functionality	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Message will have been sent	-	-

Operation: Press Messages button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Once the user gets here, they will	-	-
Will the user notice that the correct action is available?	5	Button clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	Button expresses its purpose	-	-
Will the user be able to perform the action without effort?	5	No effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	New screen will appear	-	-

Operation: Press Text Area	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	User wants to read message	-	-
Will the user notice that the correct action is available?	3	User might not see text area (Android)	Text area blends into background on Android. On iOS it is much better	-
Will the user associate the correct action with the desired effect?	5	Yes, if the user finds the text area	-	-
Will the user be able to perform the action without effort?	5	No effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Keyboard will appear	-	-

Operation: Write Message	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	User wants to convey information	-	-
Will the user notice that the correct action is available?	5	Keyboard appears	-	-
Will the user associate the correct action with the desired effect?	5	Domain Knowledge	-	-
Will the user be able to perform the action without effort?	5	User knows how to type	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Text appears	-	-

Operation: Press Send	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	User wants to send message	-	-
Will the user notice that the correct action is available?	5	Clear button	-	-
Will the user associate the correct action with the desired effect?	5	Button states its purpose	-	-
Will the user be able to perform the action without effort?	5	No effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Message will appear as sent	-	-

Function: Handle Groups

Function: Handle Groups	Rt	Story	Problem	Cat
Will the user know where the function is available?	4	Only if they know about this functionality	Relies on users to know about the functionality	U
Will the interface give clues showing that the function is available?	5	Groups are displayed as soon as the user enters the application	-	-
Will the user associate the right clue with the desired function?	5	Yes, groups express their purpose well	-	-
Will the user associate the function with the right elements?	5	Yes, no other elements indicate a reation to Groups	-	-
Will the user get sufficient feedback to understand that the function has been performed?	-	Not applicable	Not applicable	-

Function: Enter/Exit Group	Rt	Story	Problem	Cat
Will the user know where the function is available?	4	Not all users might connect the displayed groups to logging in/out	Buttons do not explicitly express their functionality	T
Will the interface give clues showing that the function is available?	5	Yes, green vs Black color gives good signals of logged in / out	-	-
Will the user associate the right clue with the desired function?	5	Most likely users will, if they know about the functionality	-	-
Will the user associate the function with the right elements?	5	No other elements indicate relation to logging in/out	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, group colour will change	-	-

Function: Call Group	Rt	Story	Problem	Cat
Will the user know where the function is available?	3	User might expect to place calls from Home Screen	Call functionality hidden in hierarchy	H
Will the interface give clues showing that the function is available?	2	Only once the user enters the Phone screen	As above	H
Will the user associate the right clue with the desired function?	5	Once they find the clue, they will	-	-
Will the user associate the function with the right elements?	5	In the Phone screen the icon for groups is clearly marked	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, a call will have been initiated	-	-

Operation: Press Group	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to leave or enter group	-	-
Will the user notice that the correct action is available?	4	No clue is given other than color	No direct indication of logging in / out functionality	T
Will the user associate the correct action with the desired effect?	5	Yes, users will likely assume pressing the group lets them proceed with the task	-	-
Will the user be able to perform the action without effort?	5	Rewuired no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Group will change colour	-	-

Operation: Confirm last person leaving	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	3	User might not know what this means	The users might not know what it means when a group is empty	U
Will the user notice that the correct action is available?	5	"Yes" button clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	Button expresses its purpose well	-	-
Will the user be able to perform the action without effort?	5	Requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Dialogue box will disappear	-	-

Operation: Press information icon to view group	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to see who is in the group	-	-
Will the user notice that the correct action is available?	3	Icon is not clearly marked	-	-
Will the user associate the correct action with the desired effect?	5	If they see the icon they will likely connect it to group information	-	-
Will the user be able to perform the action without effort?	4	Pressing button requires precision	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Group members will be displayed	-	-

Operation: Press Phone button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to call a group	-	-
Will the user notice that the correct action is available?	5	Yes, phone icon is clearly visible	-	-
Will the user associate the correct action with the desired effect?	3	Not clear that user must go through phone screen	User might be confused by groups displayed on Home-screen	-
Will the user be able to perform the action without effort?	5	Requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, screen will display contacts	-	-

Operation: Press Group tab	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to reach a group	-	-
Will the user notice that the correct action is available?	3	Only if the "Colleagues" tab is active, and thus the group tab is visible	If the Colleagues tab is not active, the user will not see that groups are available	H
Will the user associate the correct action with the desired effect?	5	If Groups tab is visible, users will associate it with displaying groups	-	-
Will the user be able to perform the action without effort?	4	Requires precision	Text is difficult to click	H
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, groups will be displayed	-	-

Operation: Press Group	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to select the group	-	-
Will the user notice that the correct action is available?	5	Yes, Groups are clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	Yes, works as with a normal Contact	-	-
Will the user be able to perform the action without effort?	5	Requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Group will be displayed	-	-

Operation: Press Connection	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to call group	-	-
Will the user notice that the correct action is available?	5	-	-	-
Will the user associate the correct action with the desired effect?	5	Works as normal contacts	-	-
Will the user be able to perform the action without effort?	5	-	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Call is initiated	-	-

Appendix III – Comparative Enhanced Cognitive Walkthrough (ECW) of Mi PC client

Call external contact

Question	Rating	Comments
Is the user more or less likely to find the applicable function?	Same	Not as many selections of contacts, search function much more visible
Are the clues easier or more difficult to detect?	Easier	
Is the user more or less likely to associate the right clue with the right function?	Same	
Is the user more or less likely to associate the function with the correct parts of the interface?	Same	
Will the user get better or worse feedback to understand that the desired function has been performed?	Same	

Transfer an incoming call

Question	Rating	Comments
Is the user more or less likely to find the applicable function?	Less	Very confusing button, only works with connecting two ongoing calls, not direct transfer. No transition required
Are the clues easier or more difficult to detect?	Easier	
Is the user more or less likely to associate the right clue with the right function?	Less	User will try to use button, which might not work

Is the user more or less likely to associate the function with the correct parts of the interface?	Less	
Will the user get better or worse feedback to understand that the desired function has been performed?	Same	

Identify colleague as busy

Question	Rating	Comments
Is the user more or less likely to find the applicable function?	Same	Function works the same as in the mobile application
Are the clues easier or more difficult to detect?	Same	
Is the user more or less likely to associate the right clue with the right function?	Same	
Is the user more or less likely to associate the function with the correct parts of the interface?	Same	
Will the user get better or worse feedback to understand that the desired function has been performed?	Same	

Send internal message

Question	Rating	Comments
Is the user more or less likely to find the applicable function?	Same	Hidden under the contact card
Are the clues easier or more	Same	

difficult to detect?		
Is the user more or less likely to associate the right clue with the right function?	Same	
Is the user more or less likely to associate the function with the correct parts of the interface?	Same	
Will the user get better or worse feedback to understand that the desired function has been performed?	Better	Messages more clearly grouped and formatted, resembles normal messaging applications more

Read received message

Question	Rating	Comments
Is the user more or less likely to find the applicable function?	Same	Works very much the same as in mobile application
Are the clues easier or more difficult to detect?	Same	
Is the user more or less likely to associate the right clue with the right function?	Same	
Is the user more or less likely to associate the function with the correct parts of the interface?	Same	
Will the user get better or worse feedback to understand that the desired function has been performed?	Same	

Create a forwarding rule

Question	Rating	Comments
Is the user more or less likely to find the applicable function?	Less	Function is hidden in a menu, not visible in the main window
Are the clues easier or more difficult to detect?	Difficult	No clues as to where forwarding rules are available
Is the user more or less likely to associate the right clue with the right function?	Same	
Is the user more or less likely to associate the function with the correct parts of the interface?	Less	Function hidden under menu called "Settings"

Will the user get better or worse feedback to understand that the desired function has been performed?	Same	
--	------	--

Create quick forwarding rule

Question	Rating	Comments
Is the user more or less likely to find the applicable function?	Same	Looks the same as in mobile application
Are the clues easier or more difficult to detect?	Same	
Is the user more or less likely to associate the right clue with the right function?	Same	
Is the user more or less likely to associate the function with the correct parts of the interface?	Same	
Will the user get better or worse feedback to understand that the desired function has been performed?	Same	

Identify missed call

Question	Rating	Comments
Is the user more or less likely to find the applicable function?	More	A missed call is indicated by a notification symbol, absent in the mobile application
Are the clues easier or more difficult to detect?	Easier	
Is the user more or less likely to associate the right clue with the right function?	Easier	
Is the user more or less likely to associate the function with the correct parts of the interface?	Same	

Will the user get better or worse feedback to understand that the desired function has been performed?	Same	
--	------	--

Listen to voicemail

Question	Rating	Comments
Is the user more or less likely to find the applicable function?	Same	No indication in PC client either
Are the clues easier or more difficult to detect?	Same	
Is the user more or less likely to associate the right clue with the right function?	Same	
Is the user more or less likely to associate the function with the correct parts of the interface?	More	Easier access to e-mail if synchronisation with mobile device is not present
Will the user get better or worse feedback to understand that the desired function has been performed?	Same	

Settings (generalised)

Question	Rating	Comments
Is the user more or less likely to find the applicable function?	Same	Standard settings menu
Are the clues easier or more difficult to detect?	Same	
Is the user more or less likely to associate the right clue with the right function?	Same	
Is the user more or less likely to associate the function with the correct parts of the interface?	More	User might be more comfortable with regular computer settings than in mobile application

Will the user get better or worse feedback to understand that the desired function has been performed?	Same	
--	------	--

Manage Groups

Question	Rating	Comments
Is the user more or less likely to find the applicable function?	Same	Looks the same as mobile device
Are the clues easier or more difficult to detect?	Same	
Is the user more or less likely to associate the right clue with the right function?	Same	
Is the user more or less likely to associate the function with the correct parts of the interface?	Same	
Will the user get better or worse feedback to understand that the desired function has been performed?	Same	

Appendix IV – Usability test script

Ålder: _____

Sysselsättning: _____

Vilken/vilka telefon(er) har du?

Operativsystem?

Har du eller har du haft en ”jobbmobil” separat från din personliga?
Ja / Nej

Använder du eller har du tidigare använt en app relaterad till ett företags telefonväxel?
Ja / Nej

Använder du Advocos app Mi?
Ja / Nej

Arbetslivserfarenhet: _____

Om ja, beskriv vad du huvudsakligen använder/använde den till: _____

Tidigare erfarenhet av telefonväxlar i arbetet: _____

Vad använder du huvudsakligen telefonen till i arbetet?

Vilka egenskaper är viktigast för en "business"-app att ha för att du skall vilja använda den? _____

Vilka egenskaper är de värsta en app kan ha?

Detta test kommer att gå ut på att utvärdera hur användarvänligt Advocos Mi-app är, utifrån vanligt användande av appen. Du kommer att få utföra ett antal handlingar med hjälp av appen, och jag kommer att observera hur bra appen är anpassad för detta. Var alltså inte rädd för att göra fel eller inte lyckas med någonting, det är appen som utvärderas och inte du. Tänk gärna högt om vad du gör, har du några frågor så ställ dem. Eventuellt kommer jag inte att kunna svara, om du till exempel frågar om hur man gör någonting. Ljud kommer att spelas in, och dina händer kommer att filmas.

-----För nya
användare-----

Appen ger i princip möjligheten att ha sin arbetstelefon i sin mobil, samt viss tillgång till företagets telefonväxel. Exempelvis kan man vidarekoppla samtal, skicka meddelanden till kollegor, använda samtalsgrupper och hantera sin tillgänglighet. Det finns även röstbrevlåda med notis till epost.

[Genomgång av snabbguide]

-----Installera app på TS mobil/överlämna
exempelmobil-----

Inledande inställningar:

Inloggad i båda grupperna. Tid för ”inget svar till VM” = 20 S. Mobil tar alla samtal. Lägga till Jimmy Carr som kontakt. Presentationsnummer = personligt. Snabbhänvisning = Automatisk telefonist. Verifiera att menyer etc finns.

Lägg in kopplad e-post om sådan finns.

Förklara begrepp: **Softphone. Hänvisning. Samtalsgrupp. Auto attendant. Extern telefon. Intern telefon. Motringning.**

-----Inledande
enkät-----

Det första testet handlar främst om att du skall bli lite bekant med appens utseende. Jag vill att du öppnar appen och letar upp kontakten Jimmy Carr, och ringer upp honom. Antal klick _____

Vad är ditt första intryck av appen?

Det andra testet handlar om att ta emot och vidarekoppla samtal. Jag kommer att ringa upp dig, du skall svara, öppna Mi-appen och vidarekoppla samtalet till Nikola Tesla, som finns som kollega. Välj nummer själv.

Antal
klick: _____

Hur svårt var det att vidarekoppla?

TL Ring upp Nikola Tesla. Nästa steg går ut på att nå sina kollegor. Jag vill nu att du skall ringa upp mig, Erik Dellborg.

Antal klick _____

Identifierat som upptagen? Y / N. Vad skulle du normalt göra om du ville få tag i någon som var upptagen?

—

Gå till hemskärm. Skicka då istället ett meddelande till mig med texten ”ring mig”.

Klick _____

Gå till hemskärm.

Sätt nu på knapplåset på din mobil och lägg ner den. [Skicka meddelande till TS (texten: ”var är du?”)]. Du skall nu läsa meddelandet.

Antal klick 1 _____

Antal klick

2 _____

Hur svårt var det att hitta meddelandet?

Hur svårt var det att skicka meddelandet?

Upptäckte användaren meddelandet utan hjälp Y / N?

Var letade användaren efter meddelande, efter att skicka meddelande?

Nu skall vi utvärdera hänvisningar, när man vill vara otillgänglig. Mi har två olika funktioner för detta, en snabbhänvisning och en mer avancerad. Du skall få testa båda två. Jag vill att du först lägger in en hänvisning som skall börja gälla om en timme och försvinna imorgon bitti. Orsaken är ta hand om ett sjukt barn. (Hittar ”resten av dagen” N / Y efter / Y före)

Antal

klick _____

Hur svårt tyckte du att detta var?

Du inser nu att du är sen till ett möte, så du lägger in en snabbhänvisning som varar i en halvtimme.

Kan du beskriva vad du tror händer om någon nu ringer dig?

Vad händer när den går ut om en halvtimme? Vad tycker du borde hända?

Nu skall vi ta en kort paus, lägg ifrån dig mobilen så fortsätter vi om några minuter.

-----Kort paus -----

Under pausen ringer TL och lämnar ett röstmeddelande.

Då fortsätter vi, ta upp mobiltelefonen, och beskriv vad du ser.

Missat samtal upptäckt? Y / N Via Mi Y / N

Identifierat vem det är ifrån? Y / N Via Mi Y / N

Identifierat vad som hänt med samtalet? Y / N

Vad skulle du göra om du upptäckte ett missat samtal? (Nämns Voicemail? Y/N) _____

(På fråga om ifall man kan ringa till röstbrevlåda ge svar)
(Fråga ifall personen har aktiv epost på telefonen) Y / N

Jag vill nu att du ringer och lyssnar på meddelandet. Hitta nummer själv? Y / N

Nu vill jag att du skall ställa in så att samtal går till röstbrevlåda efter 25 sekunder om du ej svarar.

Antal

klick _____

Hur svårt var detta?

Bra, nu vill jag att du skall utföra ett antal inställningar. Först och främst, ställ in så att alla samtal till dig tas emot av din ”softphone”. (Antal Klick _____ Hur svårt _____) Ställ nu in så att det nummer någon ser när du ringer är dolt (Antal Klick _____ Hur svårt _____).
Ställ in så att snabbhänvisningar går till röstbrevlådan. (Antal klick _____ Hur svårt _____).

Hur tyckte du att det var att göra dessa inställningar, jämfört med hur det brukar vara att göra inställningar på en mobiltelefon? Lättare / Likvärdigt / Svårare.

Bland kontakter går det också att lägga in favoritkontakter och sortera dessa i favoritgrupper. Jag vill nu att du skapar en ny Favoritgrupp. (Antal klick _____).
Lägg nu till en person i den (Antal klick _____).

Gå till hemskärm.

Jag vill nu slutligen att du först öppnar appen och berättar vilka av grupperna du är inloggad i. Korrekt? Y / N

Nu vill jag att du berättar vilka som är inloggade i gruppen ”Back Office”. Korrekt Y/N? Rätt ansats? Y / N

Nu vill jag att du ringer en av dem som är inloggade. Korrekt utförande? Y/N

Slutenkät:

Hur estetiskt tilltalande (snyggt) var gränssnittet?

1-5: _____ 1 = Påtagligt fult, 5 = Våldigt snyggt

Hur intuitivt tyckte du att gränssnittet var?

1-5: _____ 1 = Störande dåligt, 5 = Oerhört lättförståeligt

Gick uppgifterna lättare under testets senare del?

Ja / Nej

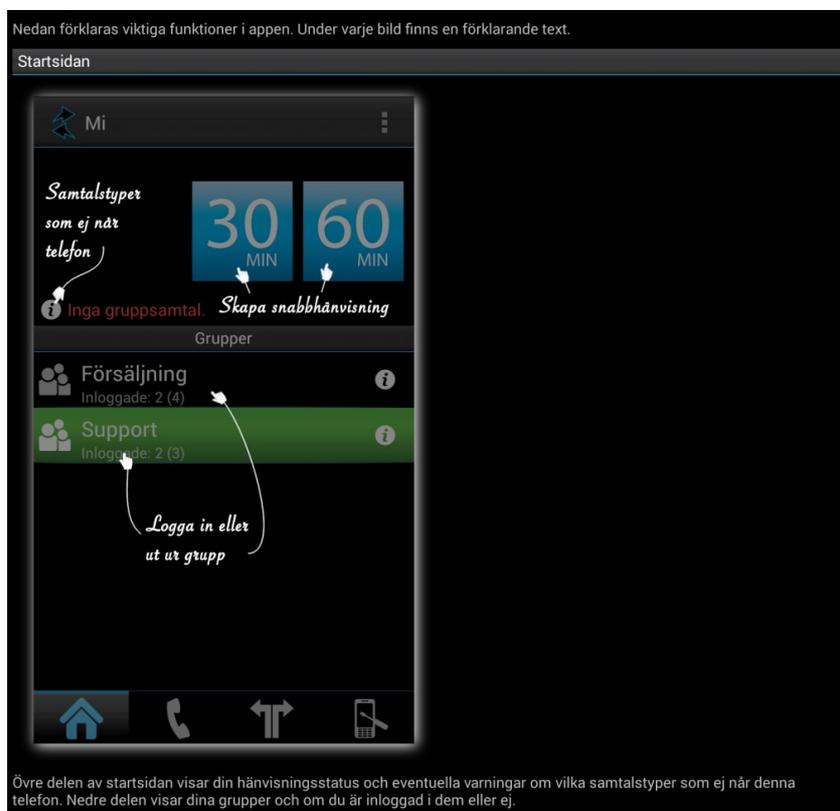
Tror du att det skulle gå lättare för dig om du gjorde om testet en gång till?

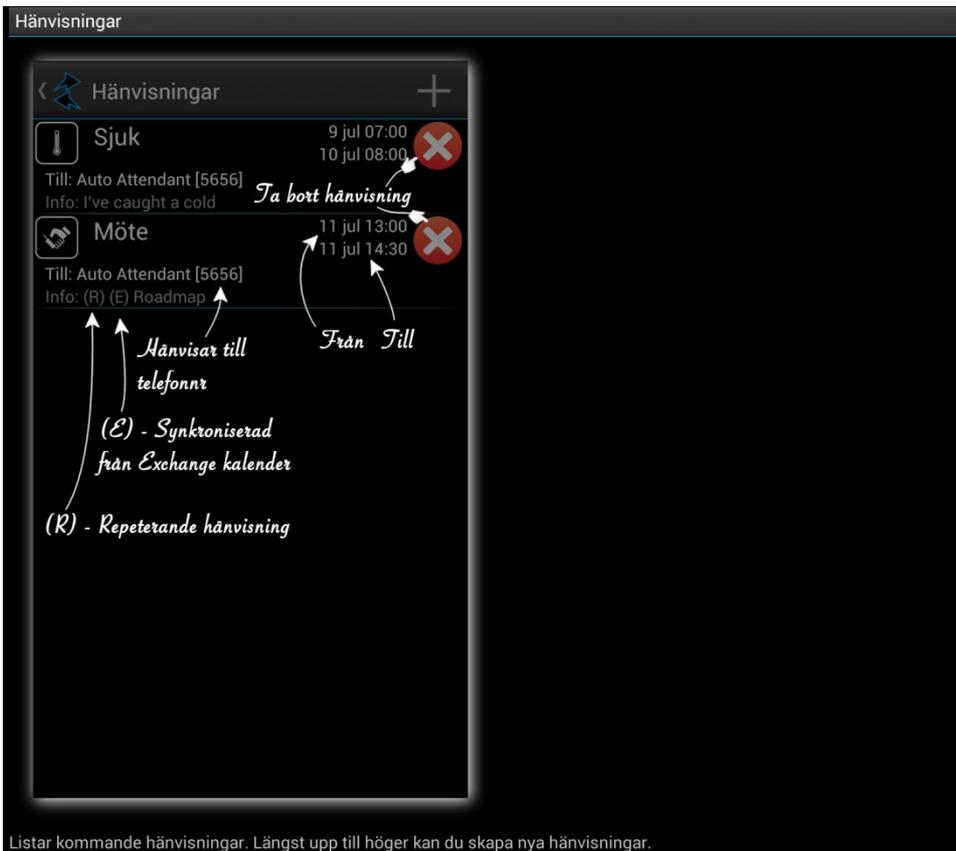
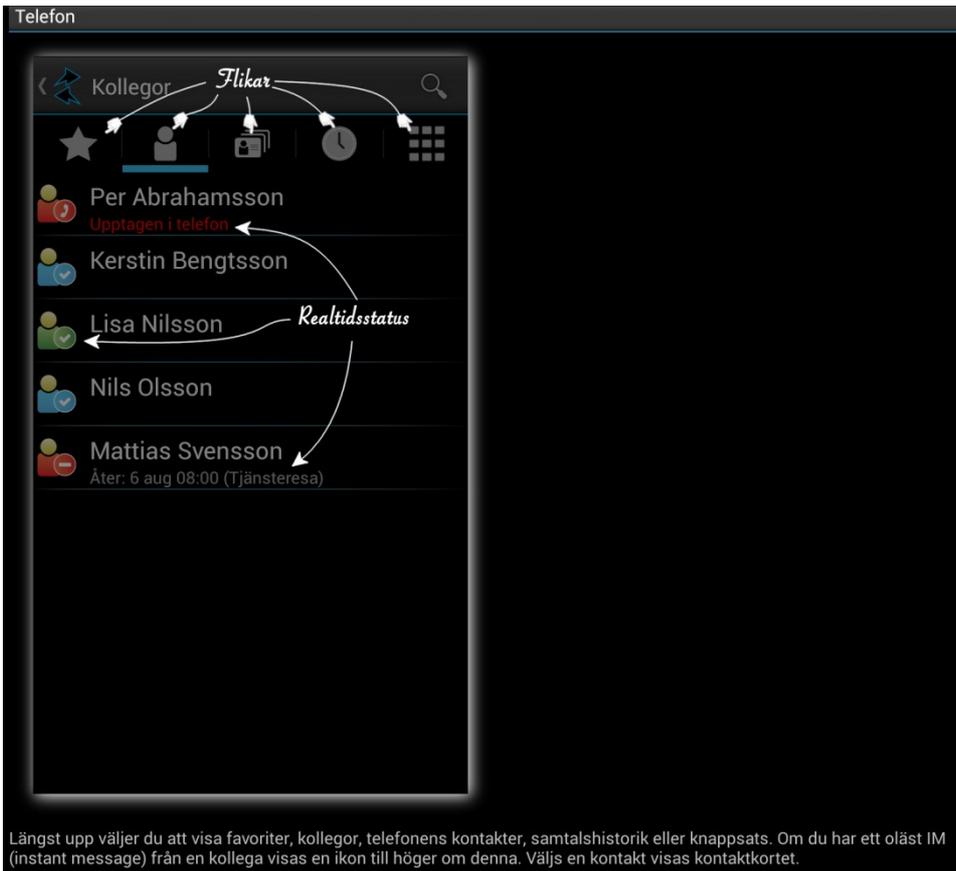
Ja / Nej

Om du fick förbättra någonting med appen, vad skulle det då vara?

Appendix V – Quick guide of Mi mobile application

Below is presented the same guide that can be found in the Mi-application, that the users were presented with at the beginning of the user test.





Systemval - Allmänt

Systemval

Allmänt

Presentationsnummer *Nummer som visas vid utringning*
+46851935771

Telefonnr. till denna mobil *För temp. byte av telefonnr.*
+4687494749

Sätt att ringa ut på *Styr utgående samtal*
Motringning

Inkommande samtal

Telefoner

Softphone (PC/Mac) *Styr personliga samtal innan de når dina telefoner*
● Personliga ● Grupp

Intern telefon

Extern telefon
● Personliga

Intern telefon 2
● Personliga ● Motringning

Inställningar för din personliga telefonväxel. Möjligheten till byte av telefonnummer till extern telefon (mobiltelefon) finns bl.a. för att du lättare ska kunna ringa billigt med motringning när du befinner dig utomlands.

Systemval - Telefoner

Systemval

Allmänt

Presentationsnummer
+46851935771

Telefonnr. till denna mobil
+4687494749

Sätt att ringa ut på
Motringning

Inkommande samtal

Telefoner *Tar emot*

Softphone (PC/Mac) *gruppsamtal*
● Personliga ● Grupp

Intern telefon *Telefon som växeln ringer upp vid motringning*

Extern telefon
● Personliga

Intern telefon 2
● Personliga ● Motringning

Tar emot samtal för ditt arbetsnr

I "Telefoner"-sektionen bestäms vilka telefoner som ska ta emot vilka samtalstyper. I exemplet ovan styrs inkommande samtal på användarens arbetsnummer till "Softphone (PC/Mac)", "Extern telefon" och "Intern telefon 2". Inkommande samtal på de grupper där användaren är inloggad i styrs till "Softphone (PC/Mac)". Växeln ringer upp "Intern telefon 2" vid "Motringning".

Appendix VI – Quantitative result tables from usability test

Italics indicate an experienced user.

Perf. = Performance, the IPA divided with the user's amount of clicks

Amount of clicks Task:	Call external contact	Transfer call	Detect busy colleague	Send text message	View text message	Place forwarding rule	Place quick forward	Identify missed call	Listen to voicemail	Change time to voicemail	Send calls to softphone	Change presentation number	Change quick forwarding place	Add favorite list	Add contact to favorite list
	IPA-Android	5	3	1	6	2	8	-	-	-	7	8	4	4	5
Android															
User 4	12	6	1	6	3	16	-	-	-	7	14	4	23	5	11
User 5	24	6	1	9	X	15	-	-	-	17	22	16	21	10	12
User 6	21	11	1	8	2	10	-	-	-	7	11	4	16	14	6
User 7	7	8	3	6	2	39	-	-	-	8	8	4	48	9	4
User 8	17	12	5	10	2	14	-	-	-	11	23	6	39	14	9
User 9	27	8	1	12	3	12	-	-	-	13	30	8	34	42	13
<i>User 14</i>	7	3	1	20	2	8	-	-	-	13	24	12	20	6	5
Mean Android	16	7,7	1,9	10	2,3	16				11	19	7,7	29	14	8,6
Perf. Android	0,3	0,4	0,5	0,6	0,9	0,5				0,6	0,4	0,5	0,1	0,4	0,5
IPA iOS	5	4	1	6	2	8	-	-	-	8	8	4	4	5	5
iOS															
User 1	8	15	3	8	4	22	-	-	-	8	13	4	14	7	17
User 2	15	7	1	10	2	11	-	-	-	18	48	5	18	12	45
User 3	10	9	1	6	3	12	-	-	-	27	25	4	4	5	7
User 10	12	4	1	9	2	17	-	-	-	26	42	7	30	X	X
User 11	5	4	1	6	2	10	-	-	-	14	15	4	9	5	13
User 12	9	4	1	6	2	25	-	-	-	39	22	4	36	5	10
User 13	5	4	1	6	2	16	-	-	-	32	20	4	4	5	6
<i>User 15</i>	8	7	1	10	4	11	-	-	-	9	9	8	27	5	7
<i>User 16</i>	7	21	1	6	2	10	-	-	-	25	28	4	9	6	6
<i>User 17</i>	15	9	8	7	2	11	-	-	-	29	15	5	44	32	7
<i>User 18</i>	5	4	1	6	5	13	-	-	-	36	8	7	31	5	9
<i>User 19</i>	6	4	1	9	X	9	-	-	-	21	8	9	23	5	9
Average iOS	8,8	7,7	1,8	7,4	2,7	14				24	21	5,4	21	8,4	12
Perf % iOS	0,6	0,5	0,6	0,8	0,7	0,6				0,3	0,4	0,7	0,2	0,6	0,4
Mean exp users	8	8	2,2	9,7	3	10				22	15	7,5	26	9,8	7,2
Perf % exp users	0,7	0,7	0,7	0,5	0,8	0,9				0,4	0,5	0,5	0,2	0,7	0,7
Mean new users	13	7,5	1,6	7,8	2,4	17				17	23	5,7	23	11	13
Perf % new users	0,4	0,5	0,6	0,8	0,8	0,5				0,5	0,4	0,7	0,2	0,5	0,4

Difficulty rating

Task:

	Call external contact	Transfer call	Detect busy colleague	Send text message	View text message	Place forwarding rule	Place quick forward	Identify missed call	Listen to voicemail	Change time to voicemail	Send calls to softphone	Change presentation number	Change quick forwarding place	Add contact to new favorite list
Android														
User 4	-	1	-	1	2	2	-	3	5	1	3,5	1	3,5	3
User 5	-	2	-	2	1	1	-	2,5	5	3	3	2	4,5	X
User 6	-	2	-	2	2	2	-	3	5	3	2	1	4,5	3
User 7	-	1	-	2	2	3	-	1	1	2	2	1	4	2,5
User 8	-	3	-	3	2	2	-	2	5	2	4	2	4,5	2
User 9	-	2	-	2	2	1	-	2,5	4	2	3	2	3	4
User 14	-	3	-	3	1	1	-	4	5	4	3	3	5	1
Average Android		2		2,1	1,7	1,7		2,6	4,3	2,4	2,9	1,7	4,1	2,6
iOS														
User 1	-	3	-	1,5	2	2	-	5	5	4	4,5	1	3	X
User 2	-	1,5	-	1	2	1	-	2	5	2	4	2	4	4
User 3	-	3	-	1	X	4	-	3	5	4	4	1	3	1,5
User 10	-	2	-	3	1	4	-	5	5	5	4	2	5	4
User 11	-	2	-	2	2	1,5	-	3	4	2	3	1	3	2
User 12	-	2	-	1	1	3	-	4	5	5	5	1	5	3
User 13	-	2	-	1	3	2	-	4	1	4	4	2	1	2
User 15	-	4	-	3	1	2	-	3	5	2	3	3	2	3
User 16	-	3	-	1	1	1	-	2	3	4	4	2	2	1
User 17	-	2	-	2	1	3	-	3	5	4	5	2	5	4
User 18	-	2	-	2	3	2	-	1,5	5	3	2	1,5	3	1,5
User 19	-	4	-	1	X	1	-	1	5	3	1	1	3	1,5
Average iOS		2,5		1,6	1,7	2,2		3	4,4	3,5	3,6	1,6	3,3	2,5
Average exp users		3		2	1,4	1,7				3,3	3	2,1	3,3	2
Average new users		2		1,7	1,8	2,2				3	3,5	1,5	3,7	2,8

Summary per task

	Call external contact	Transfer call	Detect busy colleague	Send text message	View text message	Place forwarding rule	Place quick forward	Identify missed call	Listen to voicemail	Change time for voicemail	Send calls to softphone	Change presentation number	Change quick forwarding place	Add favorite list	Add contact to favorite list	TOTAL
Perf % Android	0,3	0,4	0,5	0,6	0,9	0,5	0,7		0,1	0,6	0,4	0,5	0,1	0,4	0,5	0,5
Perf % iOS	0,6	0,5	0,6	0,8	0,7	0,6	0,7		0,1	0,3	0,4	0,7	0,2	0,6	0,4	0,5
Diff. Rate Android		2	2,1	1,7	1,7		2,6	4,3	2,4	2,9	1,7	4,1	2,6		2,6	2,6
Diff. Rate iOS		2,5	1,6	1,7	2,2		3	4,4	3,5	3,6	1,6	3,3	2,5		2,7	2,7

Appendix VII – Summary of qualitative data

Before test

The most important characteristics of a business application is that it should be easy to learn how to use it, it should facilitate the user's work tasks, and it should be stable.

Undesirable characteristics include when the application affects the private use of the device, in terms of added costs, adverts, incessant notifications, and poorly defined boundaries between private and work related functionality.

Telephone exchanges are mainly associated with calling internally and externally, but are by some seen as a means of distributing information.

Task 1 – Calling an external contact

The phone icon works well and is clearly visible. On the Phone screen there is a lot of information and options, making navigation less efficient. Navigation is even more hindered by the difficulty in finding the search function, and that it only searches in the active tab. There is also a conflict between the phrasing “External contacts” and “Others”.

Many users have a mental model where phone functionality is separated from contacts. However, all users found the screen which displays contacts, so no real obstacle exists here.

Finding external contacts is more bothersome using the application than using the phone's native phone book, which causes many users not to call external contacts via the application. This means their private mobile phone number is distributed instead of their work number, which diminishes the positive effects of using the application.

Task 2 – Transferring a call

What is deemed most difficult in transferring calls is to transition from the native call screen to the Mi application. Even users who knew how to do this beforehand sometimes looked for means of switching to the application directly from the call screen.

Once the application had been reached, the majority of users found it easy to proceed. Some problems occurred once the users reached the contact card, where they expressed uncertainty as to what to click in order to transfer the call. More obvious distinction between information and functionality was desired.

Even after a message box stating that the call had been transferred, some users wanted more feedback. This included information regarding if the recipient had picked up the call, which number the recipient saw as an incoming call, and a wish to be able to get the call back if the recipient did not take the call, rather than letting it be forwarded.

Task 3 – Identify colleague as busy

Most users refrain from calling when they identify someone as busy. They either send an e-mail or text message, or try to call back later instead. Some had a function which reminded them to call back later, should they forget. Some also appreciate functionality which lets them automatically send a text message.

The many options (connections) on the contact card led some to believe only a certain

number is busy, meaning they can reach the contact on another phone number, leading them to place the call anyway.

Several users stated that they had identified the contact as busy but called anyway, since the test leader told them to.

Functions such as call queue and voicemail was mentioned sparsely throughout the tests, but more frequently by actual users, indicating that these functions are associated with work related telephony.

Task 4 – Sending and receiving messages

The messaging function works relatively well, but is used very sparsely by the actual users. This could be caused by the fact that the functionality is hidden under the contact card, that other messaging applications are used instead, and that users cannot send messages to external contacts. The latter leads the users to rely on e-mail or text messages, since it works for all contacts.

Problems with the messaging function includes that the contact card is poorly designed in regards to displaying the function, that notifications do not always work properly (might be caused by native settings), the messaging history needs to be better grouped and displayed, and that the text field for typing the message is difficult to find for android users.

Task 5 – Creating a new forwarding rule

The forwarding functionality is intuitive and works well. Symbols and cues are generally clear, and most users successfully created a rule with only minor efficiency problems.

Potential improvements for the forwarding functionality include:

- Having the Rest of the Day button more clearly express its functionality, and placing it so that users find it before they set a To-time
- Emphasise the button to create a new rule
- Clarify that the user needs to click the time to be changed (on the iOS version)
- The user should be able to make change to a rule without having to delete it and create a new one.

Task 6 – Creating a Quick forwarding rule

Once the rule had been placed the phone clearly displayed relevant information. The vast majority of users could correctly identify where calls were forwarded to during the rule.

Identified problems include:

- It is not obvious that the buttons are used to create forwarding rules. Several users placed normal forwarding rules, even after being told to create a rule as swiftly as possible, and being previously informed that quick forwarding rules existed.
- The interaction between Call Groups and forwarding rules is not clear to the users. Opinions were split regarding whether group calls would reach a logged

in user during a forwarding rule.

- All users assumed they would be logged in automatically once the rule expired, had they been logged out of the groups while adding the rule, which is not the case.

Task 7 – Identify a missed call

The biggest issue around identifying missed calls was that notifications only appear in the phones native applications, not in the Mi application. All users wanted an alert or notification in the Mi application.

When the call log was displayed, most user interpreted it as showing two different calls, of which one had been forwarded and one had been missed (which was not the case). The symbols were interpreted correctly, but there was still confusion. One user even got a text message (native) informing that he had a missed call, and that the caller had not left a voicemail (which the called had in fact done).

Most users either call back or send a message upon finding a missed call. The procedure often depends on whether the caller is known to the user or not, although in a work context this effect was less emphasised.

Many users stated that they would like to have contacts present in the Mi application added to their native phone book, to facilitate identifying the caller.

Task 8 – Listening to a voicemail

Only two of the users managed to successfully find and listen to the voicemail, and both did it through a received e-mail. Two main problems were identified: firstly, nothing inside the application expressed that the user had in fact received a voicemail, and secondly, there was no way to call and listen to the voicemail unless the user previously knew the designated number (9000).

Some users stated that e-mail would be a convenient way of receiving voicemails, but several users also stated that they already felt they received too many e-mails, and did not want even more.

The users mainly looked for voicemail in connection to the missed call, and amongst the contacts.

Task 9 – Settings

The setting are generally considered to be on par with regular mobile phone settings. What confused most user was the division of the settings into two separate menus. More confusion and frustration arose over the inconsistency of “Save” options throughout the various settings. Several users also wanted more feedback as to what had been affected by the settings.

Some general observations included that the users tended to look for settings regarding call handling either under the settings grouped under “Incoming calls” or under forwarding rules. They also often searched for setting in connection to the functionality affected by the settings (for example settings regarding forwarding rules were looked for on the forwarding screen, to no avail). Sever user expressed that they considered the

navigation to be logical, but that they were unfamiliar with the terminology.

Task 10 – Create a new Favourites list

Only minor problems occurred whilst creating favourite lists. These included that some users found the difference to call groups unclear, that the button to reach the favourite lists was small and unclear, and that the button to save the list was unclear.

Task 11 – Add colleague to favourites list

Most users wished to add contacts directly from the newly created list, but most succeeded without problems anyhow.

Task 12 – Group handling

Only minor issues were identified in relation to call groups. Some users did not link the green colour to being logged in, and several users expressed that the button to view the group should be more distinct. Some also expressed that it seemed likely one could log in or out by mistake.

After test

General comments included:

- Legibility of text could be improved
- The Home screen could be more welcoming
- The bottom menu should be present on all screens (for Android)
- Feedforward was desired, to let the users know what various functions do before trying them

Appendix VIII – Enhanced Cognitive Walkthrough (ECW) of new concepts

In the following tables, a number of abbreviations are used for display purposes. They are explained below:

- Rt = Rating, answer to the question in the leftmost column. 5 = very likely, 1 = Very unlikely
- Cat = Category, a categorisation of any potential usability issues, as defined by Bligård & Osvalder, 2013.

Function: Call external contact

Function: Call external Contact	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	The function is available from the Home-screen	-	-
Will the interface give clues showing that the function is available?	5	The Phone icon in the bottom menu suggests calls can be placed	-	-
Will the user associate the right clue with the desired function?	5	The phone symbol is the obvious choice for making phone calls	-	-
Will the user associate the function with the right elements?	5	As above	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, a call will have been placed	-	-

Function: Open Contact Card	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Yes, accessing contacts through phone icons is common in mobile devices	-	-
Will the interface give clues showing that the function is available?	5	Yes, the phone icon indicates this	-	-
Will the user associate the right clue with the desired function?	4	Phone icon symbolises contacts indirectly, but no direct clue of contacts until phone screen	User might search for contacts somewhere else, but it is very unlikely	T
Will the user associate the function with the right elements?	5	Yes, no other elements indicate a relation to contacts	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, the Contact Card will be opened	-	-

Function: Search for Contact	Rt	Story	Problem	Cat
Will the user know where the function is available?	4	If the user expects a search function to be available they will know it present on the Phone Screen	Depends on whether the user expects a search function	U
Will the interface give clues showing that the function is available?	5	Yes, the Magnifying glass is a common symbol for search functions	-	-

Will the user associate the right clue with the desired function?	5	Yes, no other icons indicate a relation to a search function	-	-
Will the user associate the function with the right elements?	4	The user might press the Contacts icon first, and only after this press the magnifying glass	User might think they must be on the Contacts Screen to use the search function	U
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, a text field will be visible and matching contacts will be displayed	-	-

Function: Scroll for contact	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Scrolling through a list of contacts is common amongst mobile devices	-	-
Will the interface give clues showing that the function is available?	4	No direct indication that scrolling is possible, but indirect indications by the displayed list	User might (although highly unlikely) fail to realize that scrolling is available	T
Will the user associate the right clue with the desired function?	-	Not applicable	Not Applicable	-
Will the user associate the function with the right elements?	5	Yes, no other elements indicate a relation to scrolling	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, the screen will scroll and display other contacts	-	-

Function: Apply filter	Rt	Story	Problem	Cat
Will the user know where the function is available?	3	Most likely only experienced users will know about this function	Filters are not very common in mobile devices	U
Will the interface give clues showing that the function is available?	4	Clue is given indirectly, as it implies further options are available	Users might not try the button	T
Will the user associate the right clue with the desired function?	-	Not Applicable	Not Applicable	-
Will the user associate the function with the right elements?	5	If the user is looking for filters, no other elements indicates such a relation	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, selection of contacts will change	-	-

Operation: Press Phone button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	The user wants to access contacts, and will thus try to open a phone-book	-	-
Will the user notice that the correct action is available?	5	Yes, the symbol is clearly placed in the bottom menu	-	-
Will the user associate the correct action with the desired effect?	5	Yes, clicking a button usually opens a corresponding screen	-	-
Will the user be able to perform the action without effort?	5	Yes, clicking the icons require little in terms of information processing or response formulation	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the screen will change	-	-

Operation: Press search button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, if the user looks for a search function they will try to initiate it	-	-
Will the user notice that the correct action is available?	5	Yes, the magnifying glass icon is clearly placed in the top menu	-	-
Will the user associate the correct action with the desired effect?	5	Yes, the magnifying glass is a common icon for search functions	-	-
Will the user be able to perform the action without effort?	5	Yes, clicking the icons require little in terms of information processing or response formulation	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, a text field and keyboard will appear	-	-

Operation: Enter contact name	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user is looking for a specific contact	-	-
Will the user notice that the correct action is available?	5	Yes, text area and keyboard clearly appears	-	-
Will the user associate the correct action with the desired effect?	5	Yes, typing the name of the contact is how almost all search functions work	-	-
Will the user be able to perform the action without effort?	5	Yes, typing a name requires little effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, list of contacts will change	-	-

Operation: Press Contact button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the contact want to find a list of all contacts	-	-
Will the user notice that the correct action is available?	5	Yes, the contact icon is present in the top menu	-	-
Will the user associate the correct action with the desired effect?	5	Yes, the user wants to open a list of contacts, which is commonly done by pressing a similar button	-	-
Will the user be able to perform the action without effort?	5	Yes, pressing a button requires little effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, a list of all contacts will appear	-	-

Operation: Scroll to contact	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, accessing a contact is commonly done by scrolling	-	-
Will the user notice that the correct action is available?	4	Most users know that scrolling is used (domain knowledge)	Some users might not be aware of the concept of scrolling	U
Will the user associate the correct action with the desired effect?	5	Yes, if they know there are more contacts in the list, they will try to scroll	-	-
Will the user be able to perform the action without effort?	4	Depending on where the contact is in the list, the user might have to scroll a lot	User might require some time to find the right contact	P
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the list of contacts will change	-	-

Operation: Click on Contact	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to access contact information and/or functionality	-	-
Will the user notice that the correct action is available?	5	Contacts are clearly shown	-	-
Will the user associate the correct action with the desired effect?	4	Most users know that clicking on a contact opens it	Users might (but highly unlikely) not realise the contact can be clicked to access information and functionality	U
Will the user be able to perform the action without effort?	5	Clicking a contact requires neither effort nor precision	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Ye, contact card is opened	-	-

Operation: Press call button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user wants to call the contact	-	-
Will the user notice that the correct action is available?	5	Yes, call button is clearly marked	-	-
Will the user associate the correct action with the desired effect?	5	Yes, a phone symbol is universally accepted as a symbol for calling	-	-
Will the user be able to perform the action without effort?	5	Pressing the button requires little effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, a call will have been initiated	-	-

Function: Transfer call

Function: Transfer call	Rt	Story	Problem	Cat
Will the user know where the function is available?	4	The user will assume a call must be ongoing in order to transfer it, but might not know functionality is available	Not all users might know that transferring calls is possible	U
Will the interface give clues showing that the function is available?	5	Once a call is ongoing the interface clearly shows functionality	-	-
Will the user associate the right clue with the desired function?	5	Transfer call button clearly indicates its purpose	-	-
Will the user associate the function with the right elements?	4	Depends on the user's own phone's call screen	Not all phones' call screens look the same	U
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, the call will have been transferred	-	-

Operation: Press Transfer Call pop-up	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, if the user wants to transfer the call	-	-
Will the user notice that the correct action is available?	5	Yes, pop-up clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	Yes, pop-up clearly expresses its purpose	-	-
Will the user be able to perform the action without effort?	5	Pressing button requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, screen will change	-	-

Operation: Press Transfer Call button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to transfer the call	-	-
Will the user notice that the correct action is available?	5	Yes, only two buttons on screen	-	-
Will the user associate the correct action with the desired effect?	5	Yes, the button clearly states its purpose	-	-
Will the user be able to perform the action without effort?	5	Yes, there are very few options to choose from	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the screen will change	-	-

Operation: Click Contact	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to transfer the call to a certain recipient	-	-
Will the user notice that the correct action is available?	5	Yes, contacts are clearly visible	-	-
Will the user associate the correct action with the desired effect?	4	The user might not know that they should click a contact	Users might look for a button which says "Transfer"	T
Will the user be able to perform the action without effort?	5	Yes, clicking a contact requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the call will have been transferred	-	-

Operation: Click Connection	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to transfer the call	-	-
Will the user notice that the correct action is available?	5	Yes, only two buttons on screen	-	-
Will the user associate the correct action with the desired effect?	4	User might not know difference between the different connections	Not all users might know what the different connections mean	U
Will the user be able to perform the action without effort?	5	Yes, there are very few options to choose from	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the Screen will change	-	-

Function: Create forwarding rule

Function: Create forwarding rule	Rt	Story	Problem	Cat
Will the user know where the function is available?	4	If the user has been informed about the functionality they will	This functionality is not familiar to all users	U
Will the interface give clues showing that the function is available?	5	The forwarding symbol is visible in the bottom menu	-	-
Will the user associate the right clue with the desired function?	4	They will if they are previously familiar with the functionality	Some user might be unfamiliar with functionality	-
Will the user associate the function with the right elements?	5	No elements falsely indicate a relation to forwarding	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, the Home-screen will display an active forwarding rule	-	-

Function: Create regular Forwarding rule	Rt	Story	Problem	Cat
Will the user know where the function is available?	4	Users will if they have previously informed regarding the functionality	Some users might be unfamiliar with the functionality	U
Will the interface give clues showing that the function is available?	5	The forwarding symbol appears clearly in the bottom menu	-	-
Will the user associate the right clue with the desired function?	4	Depends on previous knowledge, but new users might guess based on process of elimination	New users might not have the required knowledge	U
Will the user associate the function with the right elements?	4	Users might think quick forwarding rule can be used	Similar functionality appears in several places	T
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, a new forwarding rule has appeared on the screen	-	-

Function: Set From-time	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	The user will assume time is set for a forwarding rule	-	-
Will the interface give clues showing that the function is available?	5	Both text and a button	-	-
Will the user associate the right clue with the desired function?	5	Text and time indicates time should be set	-	-
Will the user associate the function with the right elements?	5	No other elements indicate a From-time	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Displayed time will have changed	-	-

Function: Set To-time	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	The user will assume time is set for a forwarding rule	-	-
Will the interface give clues showing that the function is available?	5	Both text and a button	-	-
Will the user associate the right clue with the desired function?	5	Text and time indicates time should be set	-	-
Will the user associate the function with the right elements?	5	No other elements indicate a From-time	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Displayed time will have changed	-	-

Function: Set Forwarding place	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	The user will assume all settings are done on the screen	-	-
Will the interface give clues showing that the function is available?	5	Appropriate text and button	-	-
Will the user associate the right clue with the desired function?	5	Default choice indicates functionality	-	-
Will the user associate the function with the right elements?	5	No other elements indicate relation to forwarding place	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Displayed choice will change	-	-

Function: Add more information	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	The user will look for it where all other settings are managed	-	-
Will the interface give clues showing that the function is available?	5	Appropriate text and button	-	-
Will the user associate the right clue with the desired function?	5	Clearly marked text	-	-
Will the user associate the function with the right elements?	4	User might confuse information and Reason	Users might not know wheter Reason is displayed or not	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, information will be displayed	-	-

Operation: Press Quick forward button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	The user wants to add a forwarding rule	-	-
Will the user notice that the correct action is available?	5	Buttons clearly visible on Home-screen	-	-
Will the user associate the correct action with the desired effect?	5	Symbol and text indicate function well	-	-
Will the user be able to perform the action without effort?	5	Clicking buttons require no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Home-screen will display active forwarding rule	-	-

Operation: Press Forwarding button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	User want to add a regular forwarding rule	-	-
Will the user notice that the correct action is available?	5	The button is clearly visible	-	-
Will the user associate the correct action with the desired effect?	4	Depends on whether the user recognises the symbol, but many new users might use the process of eliminations	Not al new users might recognise the symbol	U
Will the user be able to perform the action without effort?	5	Pressing the button requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, screen will change	-	-

Operation: Press Add New Rule button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to create a new rule	-	-
Will the user notice that the correct action is available?	5	The button is clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	Yes, purpose of the button is very obvious	-	-
Will the user be able to perform the action without effort?	5	Pressing the button requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, screen will change	-	-

Operation: Click on a Reason	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, user will realise they must select a reason	-	-
Will the user notice that the correct action is available?	5	Yes, no other actions are available	-	-
Will the user associate the correct action with the desired effect?	5	Yes, the reasons are clearly expressed	-	-
Will the user be able to perform the action without effort?	4	The user might struggled to find the most appropriate reason	A lot of choices are available, which might take time to read	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the screen will change	-	-

Operation: Press From-time button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user will want to set a time for the forwarding	-	-
Will the user notice that the correct action is available?	5	Yes, there is a clearly marked button	-	-
Will the user associate the correct action with the desired effect?	5	Yes, buttons are clearly labeled, and marked with a st time	-	-
Will the user be able to perform the action without effort?	5	Pressing the button requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the screen will change	-	-

Operation: Turn dials	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to change the time	-	-
Will the user notice that the correct action is available?	5	Yes, clearly visible dials	-	-
Will the user associate the correct action with the desired effect?	5	Yes, turning dials to set time is common in touch devices	-	-
Will the user be able to perform the action without effort?	4	Scrolling through the minute dial might take a lot of time	The minute dial has very meny steps	T
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Dials will turn	-	-

Operation: Click Shortcut button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	4	The users will use the shortcuts if they are familiar with them, or realise what they mean	Not all users might guess the meaning of the shortcuts	T/U
Will the user notice that the correct action is available?	5	Buttons are clearly visible	-	-
Will the user associate the correct action with the desired effect?	4	The user will, provided they understand the effect	Effect of some shortcuts is not obvious	-
Will the user be able to perform the action without effort?	5	Pressing buttons require no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Dials will turn to defined time	-	-

Operation: Click OK-button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	The user is done with the function	-	-
Will the user notice that the correct action is available?	5	Button is clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	Button expresses its purpose clearly	-	-
Will the user be able to perform the action without effort?	5	Pressing the button requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Screen will change	-	-

Function: Send internal message

Function: Send Message	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Yes, message symbol in home menu clearly indicates this	-	-
Will the interface give clues showing that the function is available?	5	Yes, the envelope icon is clearly visible in the bottom menu	-	-
Will the user associate the right clue with the desired function?	5	Yes, the envelope icon is commonly used for messaging	-	-
Will the user associate the function with the right elements?	5	Yes, no other elements indicate a relation to messages	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, Message interface will appear	-	-

Function: Select Conversation	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	The list of conversations is displayed immediately on the Message screen	-	-
Will the interface give clues showing that the function is available?	5	Yes, several conversations are displays	-	-
Will the user associate the right clue with the desired function?	5	Yes, conversations are common in messaging functions	-	-
Will the user associate the function with the right elements?	5	Yes, no other elements indicate a relation to conversations	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, a conversation will clearly have been selected	-	-

Function: Create new Conversation	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Yes, such functions are commonly found on a Message screen	-	-
Will the interface give clues showing that the function is available?	5	Yes, the interface shows clearly a button for creating new conversations	-	-
Will the user associate the right clue with the desired function?	5	Yes, the clue can mean nothing other than the intended effect	-	-
Will the user associate the function with the right elements?	5	Yes, no other elements indicate a relation to creating new conversations	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, the process of creating a message will continue	-	-

Function: Compose message	Rt	Story	Problem	Cat
Will the user know where the function is available?	5	Yes, creating messages is typically done via a conversation in modern devices	-	-
Will the interface give clues showing that the function is available?	5	Yes, the screen shows a text field and a keyboard	-	-
Will the user associate the right clue with the desired function?	5	Yes, this is how messages are commonly composed	-	-
Will the user associate the function with the right elements?	5	Yes, no other elements indicate a relation to writing messages	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, entered text will appear on the screen	-	-

Operation: Click Message button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to send a message	-	-
Will the user notice that the correct action is available?	5	Yes, the icon is clearly visible in the bottom menu	-	-
Will the user associate the correct action with the desired effect?	5	Yes, pressing a button usually opens a corresponding screen	-	-
Will the user be able to perform the action without effort?	5	Yes, pressing a button requires little effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the screen will change	-	-

Operation: Click existing conversation	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, if the user want to write in an existing conversation, this is the normal procedure	-	-
Will the user notice that the correct action is available?	5	Yes, conversations are clearly listed	-	-
Will the user associate the correct action with the desired effect?	5	Yes, clicking on conversations usually opens them	-	-
Will the user be able to perform the action without effort?	5	Yes, clicking the conversation requires little effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, th conversation will open	-	-

Operation: Click Create new Conversation button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, if the user does not see an ongoing conversation with the desired contact they will try to create a new one	-	-
Will the user notice that the correct action is available?	5	Yes, the button is clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	Yes, clicking the button signals a new conversation will be started	-	-
Will the user be able to perform the action without effort?	5	Yes, clicking the button requires little effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the process of sending a message will continue	-	-

Operation: Click Contact	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to send a message to the contact	-	-
Will the user notice that the correct action is available?	5	Yes, a list of contacts will be displayed	-	-
Will the user associate the correct action with the desired effect?	5	Yes, clicking on a contact usually selects them in this context	-	-
Will the user be able to perform the action without effort?	5	Yes, though they might have to scroll for a bit	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the screen will change	-	-

Operation: Click text field	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Clicking a text field is common when a user wants to write a text	-	-
Will the user notice that the correct action is available?	5	Yes, the textfield is clearly marked	-	-
Will the user associate the correct action with the desired effect?	5	Yes, text field are where text is usually entered	-	-
Will the user be able to perform the action without effort?	5	Yes, clicking the text field requires little effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, a keyboard will appear	-	-

Operation: Write message	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user has information they want to convey	-	-
Will the user notice that the correct action is available?	5	Yes, there is a keyboard and a text field displayed on the screen	-	-
Will the user associate the correct action with the desired effect?	5	Yes, using a keyboard to type is normal	-	-
Will the user be able to perform the action without effort?	5	No more effort is required than to write a normal message	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, text will appear	-	-

Operation: Click Send button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user wants to send the message	-	-
Will the user notice that the correct action is available?	5	Yes, there is a send button	-	-
Will the user associate the correct action with the desired effect?	5	Yes, a Send button usually implies that the message will be sent	-	-
Will the user be able to perform the action without effort?	5	Yes, no effort is required to press the button	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, message will appear in the displayed conversation	-	-

Function: Identify missed call

Function: Identify missed call	Rt	Story	Problem	Cat
Will the user know where the function is available?	4	Users might not know that the Mi application has this function, but most will expect it	Some users might not think it will appear in connection to the application	U
Will the interface give clues showing that the function is available?	5	Notifications that something has happened	-	-
Will the user associate the right clue with the desired function?	5	Symbol is associated with a new event	-	-
Will the user associate the function with the right elements?	5	Yes, users will press the indicated element	-	-
Will the user get sufficient feedback to understand that the function has been performed?	5	Yes, users will be aware of the missed call	-	-

Operation: Press Mi-icon	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, users want to see what the indication means	-	-
Will the user notice that the correct action is available?	5	Yes, the icon is marked by the notification symbol	-	-
Will the user associate the correct action with the desired effect?	5	Yes, pressing the icon usually opens the application	-	-
Will the user be able to perform the action without effort?	5	Yes, pressing the icon requires no efforts	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, application will open	-	-

Operation: Click Phone button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Users will want to follow the trail of notifications	-	-
Will the user notice that the correct action is available?	5	Phone symbol is clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	Yes, clicking the Phone button will take the user to the missed call screen	-	-
Will the user be able to perform the action without effort?	5	Yes, pressing the button requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, screen will change	-	-

Operation: Click highlighted call	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user will want to know about the call	-	-
Will the user notice that the correct action is available?	5	Yes, the missed call is displayed	-	-
Will the user associate the correct action with the desired effect?	5	Yes, the missed call is highlighted	-	-
Will the user be able to perform the action without effort?	5	Yes, pressing the call requires no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, the missed call will be displayed	-	-

Operation: Click Listen to Voicemail button	Rt	Story	Problem	Cat
Will the user try to achieve the right effect?	5	Yes, the user will see they have a new voicemail and will want to listen to it	-	-
Will the user notice that the correct action is available?	5	Yes, the button is clearly visible	-	-
Will the user associate the correct action with the desired effect?	5	The button is clearly marked	-	-
Will the user be able to perform the action without effort?	5	Clicking the button will require no effort	-	-
Will the user get sufficient feedback to understand that the action has been performed correctly?	5	Yes, voicemail will be dialed	-	-

