



**HELSINKI METROPOLIA UNIVERSITY OF APPLIED
SCIENCES**

Master's Degree in Business Informatics

Master's Thesis research

**USABILITY STUDY FOR SAILFISH OPERATING
SYSTEM.**

Author: Elena Xydaki

Tutor: Thomas Rohweder,

DSc(Econ)

Supervisor from Jolla Oy:

Tim McDonald, Head of

Marketing

ABSTRACT

Name: Elena Xydaki	
Title: Qualitative Usability Study for Sailfish Operating System.	
Date: 05.05.2014	Number of pages: 63 + 5 appendices
Degree Programme: Master's Degree in Business Informatics	
Instructor: Thomas Rohweder, Principal Lecturer	
<p>Usability is a fundamental product quality characteristic and one of the most important factors in the success of a software product. This Master's Thesis is a case study of a smartphone startup Jolla Ltd. and explores the usability of Jolla's Sailfish operating system.</p> <p>Jolla smartphone, the first unveiled device is powered by the Sailfish operating system, which introduces new gestures and is built to optimize users' experience by less taps and finger moves. Consistent understanding and analysis of user experience in managing user interface paradigm is critical for Jolla Ltd. Thus the study explored the usability of the Sailfish operating system and identified the unique advantages of Jolla smartphone in terms of usability from the users' point of view.</p> <p>The framework of this research was based on an overview of the best-documented practices of usability concept and its evaluation methods. The empirical part of the study included ten one-on-one sessions with Jolla owners and potential Jolla buyers. These sessions consisted of questionnaires, interviews and test tasks.</p> <p>The research findings were grouped to enable an analysis on the following main subjects: product insights, usability of Sailfish operating system, users' expectations in terms of usability and experience in using applications. The unique advantages of Jolla were identified based on the opinions of the case study participants.</p> <p>The study resulted in an analysis of the above-mentioned findings and practical recommendations such as: (1) optimizing startup wizard, (2) enabling different modes for advanced and new users, (3) implementing a "back" button gesture and task completed notification and identifying a new target group.</p>	
Key words: usability study, user experience, usability	

ABSTRACT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

1. INTRODUCTION	1
1.1 The case company and industry overview	1
1.2 Business challenge and the research objectives	2
2. THE RESEARCH APPROACH	4
2.1 The study method and the research objectives breakdown	4
2.2 The thesis flowchart design	6
2.3 Data collection and analysis methods	7
2.4 Metrics	8
3. THE BEST DOCUMENTED PRACTICES OF USABILITY	10
3.1 Usability and it's significance in software engineering	10
3.2 Usability approaches in different design philosophies	14
3.2.1 User-centered design	15
3.2.2 Goal-directed design	16
3.2.3 Activity-centered design	17
3.3 Usability as an aspect of user experience	17
3.4 Usability evaluation methods	20
3.4.1 Inspection usability evaluation methods	20
3.4.2 Empirical usability evaluation methods	21
3.4.3 Usability testing	24
3.5 The thesis conceptual framework for the usability study based on literature review and the best documented practices	26

4. THE USABILITY STUDY PROCEDURE AND FINDINGS	28
4.1 Detailed description of conducted usability study for the case company Jolla Ltd	28
4.1.1 The extensive research objectives breakdown identified by the case company	29
4.1.2 The data collection design	30
4.1.3 The usability study session flowchart	31
4.1.4 The usability study techniques, evaluation methods and the metrics	32
4.2 The usability study findings	35
5. THE RESEARCH FINDINGS ANALYSIS AND THE THESIS PROPOSALS FOR THE CASE COMPANY JOLLA LTD	36
5.1 Analysis of Jolla owners usability study findings	36
5.1.1 Jolla's insights and features evaluation	36
5.1.2 Usability, learnability and intuitiveness of Sailfish OS	40
5.1.3 Smartphone owners expectations of Jolla and its usability	41
5.1.4 Users' experience of using applications	43
5.2 The analysis of non-Jolla users usability study findings	44
5.2.1 Smartphone features importance and Jolla's insights evaluation	44
5.2.2 Usability, learnability and intuitiveness of Sailfish OS	47
5.2.3 Non-Jolla users expectations of Jolla and its usability	49
5.2.4 Users' experience of using applications	50
5.2.5 Jolla's unique advantages in terms of usability	50
5.3 The analysis summary, the unique advantages identification and the proposals for the case company	52
5.3.1 Product insights and the Jolla's unique advantages in terms of usability	52
5.3.2 The usability analysis summary and the proposals to enhance usability of Sailfish OS	53
5.3.3 The identified areas for improvement	56
5.3.4 New target group proposal	57

6. CONCLUSION	58
6.1 Conclusion	58
6.2 Validity and Reliability	61
REFERENCES	64
APPENDIXES	66
Appendix 1.*	
Interview questions, questionnaire and test tasks for Jolla owners.	66
Appendix 2.*	
Interview questions, questionnaire and usability test tasks for non-Jolla users.	70
Appendix 3.*	
Findings from Jolla’s qualitative usability study with Jolla owners.	73
Appendix 4.*	
Findings from Jolla’s qualitative usability study with non-Jolla users.	81
	1q
Appendix 5*.	
Detailed description of Jolla owners and non-Jolla users comments regarding experience of managing Sailfish OS UI.	88

*The research findings and the detailed description of users comments is confidential information and a property of Jolla Ltd. It is included into Master’s Thesis Appendixes 3, 4, 5 and not available for publishing, may be obtained from the the author by Jolla Ltd. permission

ABBREVIATIONS

ACD	Activity-centered design
IEEE	Institute of Electrical and Electronics Engineers
ISO	The International Organization of Standardization
IT	Information Technology
Jolla	mobile phone produced by Jolla Ltd, that runs the Sailfish OS
GDD	Goal-directed design
HCI	Human-computer interaction
HQ	Headquarters
NPS	Net Promoter Score
OS	Operating System
SAP	SAP AG, German multinational corporation
SE	Software Engineering
UED, UXD	User Experience Design
UI	User Interface
UCD	User-centered design
UX	User Experience

1. INTRODUCTION

1.1 THE CASE COMPANY AND INDUSTRY OVERVIEW

The case company Jolla Ltd. is Finland-based smartphone manufacturer, which was founded in Pirkkala, Finland in March 2011 by ex-workers of MeeGo. Nowadays Jolla's offices are located in Ruoholahti, Helsinki (HQ), Tampere, Finland and Hong Kong, SAR of China. Jolla, the first unveiled device powered by Sailfish operating system was released in November 2013.

Jolla's slogan "we are unlike" reflects a new vision on smartphone operating system (OS). Jolla's Sailfish OS is build to optimize users' experience by less taps and finger moves. New gestures allow quick ways to perform actions, that makes the phone experience much more efficient.

User experience analysis in managing user interface paradigm as well as identifying unique advantages of new product on the market from users' point of view is critical for Jolla Ltd.

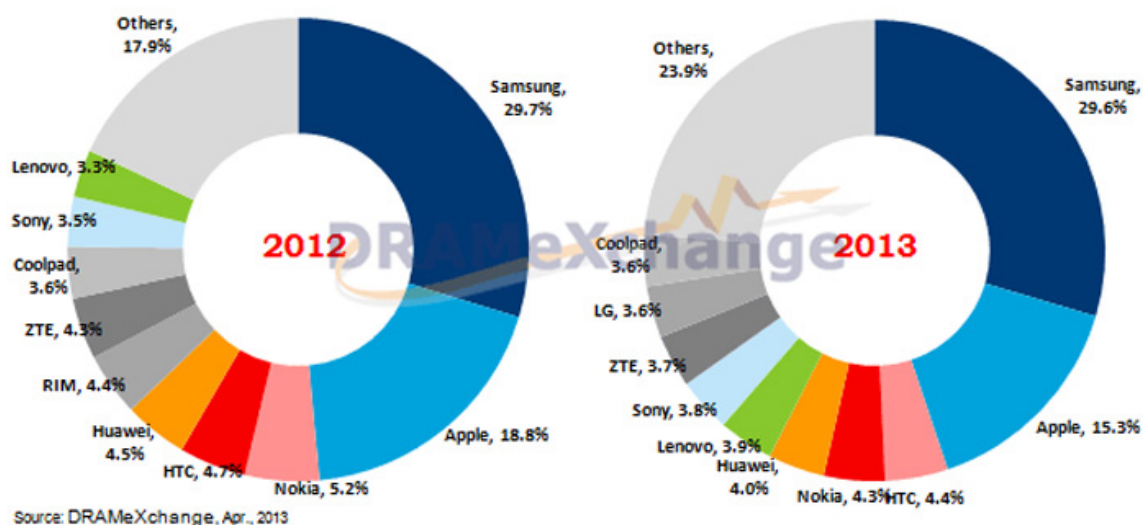
Jolla Ltd. is an emerging company penetrating smartphone and mobile operating system market. Currently, Jolla smartphones are available for orders online at its web shop to all European Union countries, Switzerland and Norway. Jolla Ltd. is expanding globally and negotiating with partners in several countries, including Russia, India and Hong Kong.

According to Gartner Inc., sales of smartphone devices is leading in overall mobile phone market, and was accounted for fifty five percent in the third quarter of 2013, and reached their highest share to date.

Global smartphones' and mobile operating system market is rather settled at the moment as there have not been any significant changes in technology development or market share of main players during the last two years. Figure 1 below illustrates top ten smartphone manufacturers market shares in year 2013 compared to year 2012.

Figure-1 Top10 Smartphone Shipments by Brand

Top10 Smartphone Shipments by Brand



According to the Figure 1 market shares in year 2013 compared to year 2012 of top ten smartphone manufacturers remained almost the same: Samsung held leading position and its market share accounted to almost 30%, second biggest smartphone supplier is Apple, the rest of market players held less than 6% of the market each. In mobile operating system market, according to Gartner, Android is leading, its global market share in the third quarter of 2013 was over eighty percent.

1.2 BUSINESS CHALLENGE AND THE RESEARCH OBJECTIVES

Entering a mature market is always challenging. Jolla Ltd. has unique and efficient product, which might change smartphone and mobile operating systems market. New technology development has direct effect on demand, but people habits and preferences usually slow down the process.

Sailfish operating system has learning curve that requires time to learn about features and get used to it. The author supposes that introduced new gestures might be confusing for the users and in a worse case lead to the situation when Jolla owners will not manage to learn user interface paradigm. This might be a bad experience both for Jolla and users resulting in a negative attitude towards Jolla. From other side, for non-Jolla users intuitiveness of Sailfish OS is very important to enable them to perform basic tasks.

Deep understanding of user experience as well as a picture of the product through the users eyes is very important for Jolla Ltd. The objectives of the study were set accordingly:

- 1. TO EXPLORE USABILITY OF SAILFISH OPERATING SYSTEM**

- 2. TO IDENTIFY UNIQUE ADVANTAGES OF JOLLA IN TERMS OF USABILITY FROM USERS POINT OF VIEW**

Master's Thesis is organized in a form of qualitative research for smartphone startup Jolla Ltd. It includes the best-documented practices review of information technology (IT) products usability and practical part - qualitative usability study of Jolla phone powered by Sailfish OS. Practical part includes interviews, questionnaires and tasks performed on Jolla phone (Jolla) for two groups of participants: Jolla owners and non-Jolla users. The outcome of the study is practical recommendations based on Sailfish operating system usability analysis.

Usability is a fundamental aspect of product characteristics and one of the most important factors in the success of a software product. Usability can drive sales just like in Apple case and it is marketable as benefits of increasing usability far exceeding the costs.

Usability of user interface paradigm is playing increasingly important role in information technology product development. It is becoming one of the most important quality characteristics of information technology product.

2. THE RESEARCH APPROACH

This Chapter focuses on the study method, data collection and analysis methods to reach the above stated objectives.

2.1 STUDY METHOD AND THE RESEARCH OBJECTIVES BREAKDOWN

As stated in Chapter 1 the research objectives of this study, identified by Jolla Ltd were the following:

- 1. TO EXPLORE USABILITY OF SAILFISH OPERATING SYSTEM**
- 2. TO IDENTIFY UNIQUE ADVANTAGES OF JOLLA SMARTPHONE IN TERMS OF USABILITY FROM USERS POINT OF VIEW**

Based on that, case study was selected as a research method, since it refers to detailed analysis of limited number of events and their relationships. According to Robert Yin (1984), case study investigates phenomenon within its real-life context and refers to multiple sources of evidence. The author uses concept of a case study introduced by Yin (1984) and performed by the following steps:

- Identifying research objectives
- Setting up data collection and analysis techniques
- Conducting the research
- Analysis and reporting.

The research objectives were already identified in Chapter 1. The author did not work in the case company Jolla Ltd, so to verify clear and detailed understanding of the research objectives for the further research validity and to identify areas of the main interest of case company, the research objectives breakdown was created and accepted by Tim McDonald, Head of Marketing. Following Figure 2 presents the research objectives breakdown.

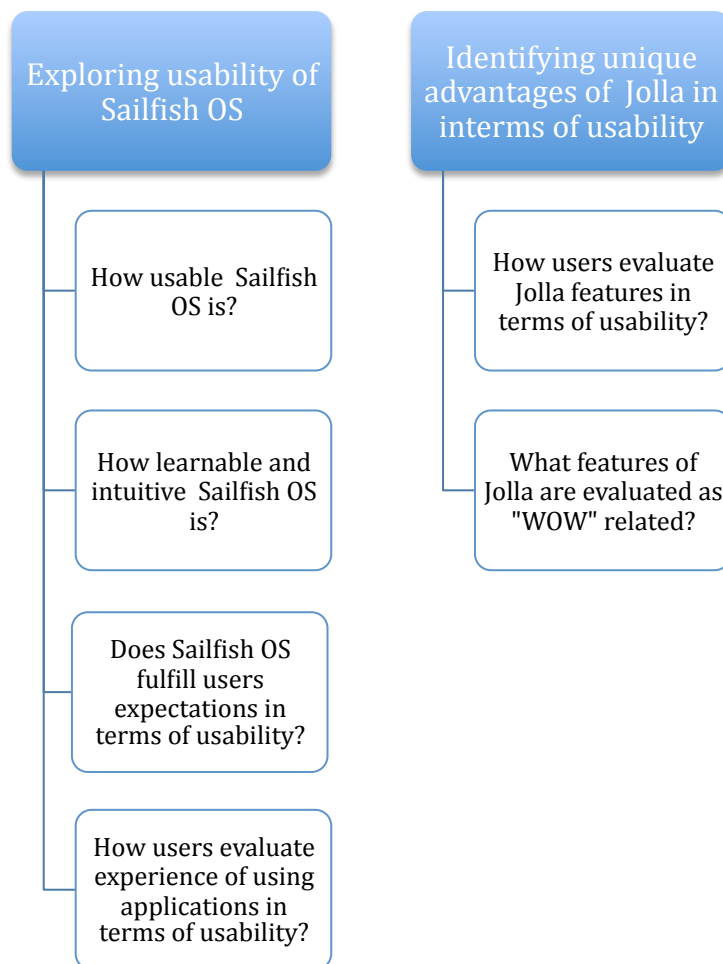


Figure 2. The research objectives breakdown, minimized version.

As shown above the main areas of the case company interest was exploring usability from users point of view in terms of learnability, intuitiveness and users' expectations. Jolla features evaluation, unique advantages and "WOW" related features identification based on users' opinions were areas of significant interest from Jolla Ltd. Tim McDonald stated that opinions of both Jolla users and potential buyers are valuable for Jolla Ltd.

Based on the research objectives breakdown, which is identified in Chapter 1, the author is able to present The Thesis flowchart design to give an overview of the main steps of this study, Figure 2 below.

2.2 THE THESIS FLOWCHART DESIGN

USABILITY STUDY FOR THE CASE COMPANY JOLLA LTD.

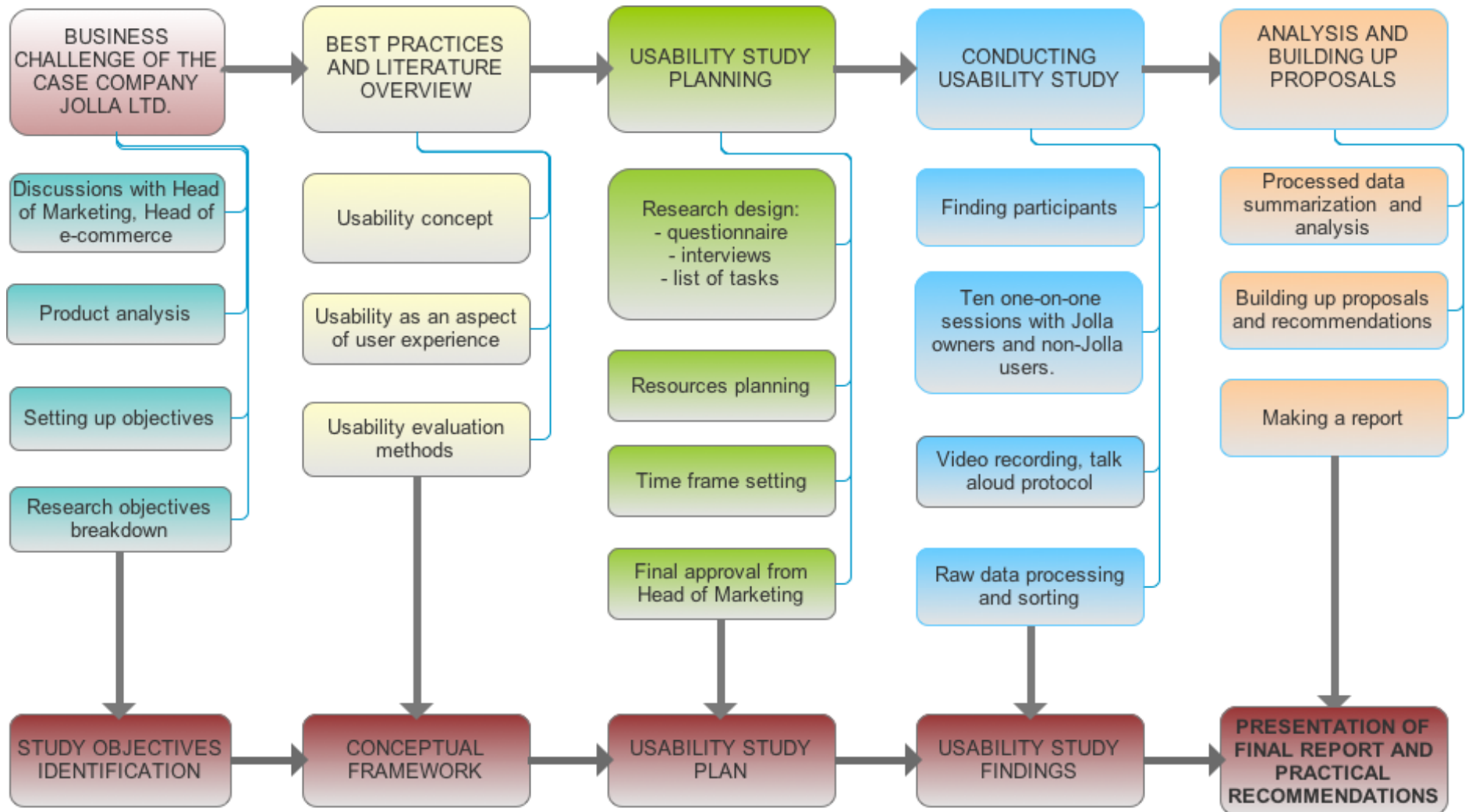


Figure 3. The Thesis flowchart design.

2.3 THE DATA COLLECTION AND ANALYSIS METHODS.

In a broad sense data collection methods are referred to either qualitative or quantitative research.

Qualitative methodology was described by Patton (1990) as following: “The detailed descriptions of situations, events, people, interactions, observed behaviors, direct quotations from people about their experiences, attitudes, beliefs and thoughts; and the analysis of excerpts or entire passages from documents, correspondence, records, and case histories.”

Quantitative research refers to phenomena investigation by mathematical or statistical data collection and usually implemented for specific research question. Rossman and El-Khawas (1987) defined quantitative approach as: “The assignment of numbers to objects, events, or observations according to some rule.”

Both methods have advantages and disadvantages, but referring to this particular study, the author believes that qualitative research has to be applied due to the following reasons:

- Qualitative method gives understanding of opinions and thoughts, and in-depth investigation of the problem. This approach is inline with research objectives of usability testing for Jolla Ltd as it seeks to deep understanding of product insights and usability from customers’ point of view. In case of Usability Testing for Jolla qualitative research allowed deeper customer understating
- Face-to-face interview and observation of participants’ behavior is traditional approach for qualitative data collection method. In this case study these techniques implementation enables rich data collection
- Qualitative research is usually applied for small sample size. The author of this study has limited resources and is not able to gather data from big data size
- Qualitative method enables data analysis already at the stage of data collection:

Quantitative research flow:

observations → analysis

Qualitative research flow:

observations → analysis → observations → analysis

Later in Chapter 4.1.2 these techniques related to data collection and analysis are described in more details.

Disadvantages of qualitative research for this study:

- Qualitative research refers to phenomena understanding, data is usually difficult to code. To enable better analysis, together with open-ended questions during the interviews, participants were asked to evaluate Jolla phone features by ranking from 1 to 5.
- Researcher's bias is usually difficult to control in a qualitative research. To overcome this disadvantage, the author made video recording of testing sessions.
- Qualitative research is time consuming. The number of participants for usability study was chosen based on principles, recommended by Jakob Nielsen and will be discussed later in Section 2.4 Validity and reliability.

2.4 METRICS

Metrics is a critical issue for any process, according to Peter Drucker: "If you can't measure it, you can't improve it."

A qualitative data such as users opinions or judgments is difficult to structure for the further analysis. To enable processing and grouping the data of users opinions about the product features the below ranking from 1 to 5 was applied, Figure 4.



Figure 4. Ranking from 1 to five for the product features evaluation.

At the task performance stage, the below metrics was applied to evaluate Jolla's usability:

- The error rate
- The time needed to complete the task
- The percentage of tasks completed

- The number of omitted steps.

The detailed description of evaluation methods and metrics is discussed in Section 4.1.4.

This Chapter presented the research approach, the data collection method and the metrics for the usability study. The following Chapter 5 is devoted to the best-documented practices and literature review of usability concept and evaluation methods. The conceptual framework in Section 3.5 represents the author's vision on usability key concepts and its relationships in this study.

3. BEST DOCUMENTED PRACTICES OF USABILITY

3.1 USABILITY CONCEPT AND ITS SIGNIFICANCE IN SOFTWARE ENGINEERING

In this Chapter usability definition, its context, characteristics and significance in software engineering (SE) are discussed. In order to identify usability the author supposes that related concepts shall be defined first.

Software engineering is a computer science discipline and according to the Institute of Electrical and Electronics Engineers, IEEE standard 610.12-1990, 1990 is "the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software".

In order to build usable product, software engineering interacts closely with another discipline called Human-computer interaction (HCI).

Human-computer interaction (HCI) in a broad sense is a study about interaction between people/users and computers, Curriculum Development Group of the ACM SIGCHI defines it as "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."

A system, which enables HCI between user and a machine/system is called *User interface (UI)* also known as human-computer interface. Interaction means input made by user to manipulate the system and output of the machine that shows the effect of user's input.

The author defined the main terms related to the study. Thus usability concept might be discussed in detail further on.

Usability as a term is used in many sciences such as Psychology, Ergonomics, Sociology, Anthropology, Computer Science etc. and has different definitions and approaches depending on field of application. Despite of range of broad usability definitions, Software Engineering and Human-Computer Interaction (HCI) communities have different vision of software usability that makes it a confusing concept.

The International Organization of Standardization (ISO) defines usability in his standard

“A set of attributes that bear on the effort needed for use and on the individual assessment of each use, by stated or implied set of users (ISO/IEC 9126, 1991)

“Usability of a product is the extent to which the 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)

“The ease with which a user can learn to operate, prepare inputs for and interpret outputs of a system or component”. (IEEE Std.610.12-1990).

Karat (1997) describes usability as: *“The usability of a product is not an attribute of the product alone it is an attribute of interaction with a product in a context of use.”*

Jeffrey Rubin (Rubin) in his “Handbook of Usability Testing” says: *“In a large part, what makes something usable is the absence of frustration in using it.”*

Usability attributes differ in various standards and models e.g. Constantine and Lockwood (1999), Shneiderman (1992), Preece et al. (1994), but on the author’s point of view, definition of Nielsen (1993), characteristics describes usability and its context more clearly.

Nielson’s view on usability is visualized in Figure 5 below:

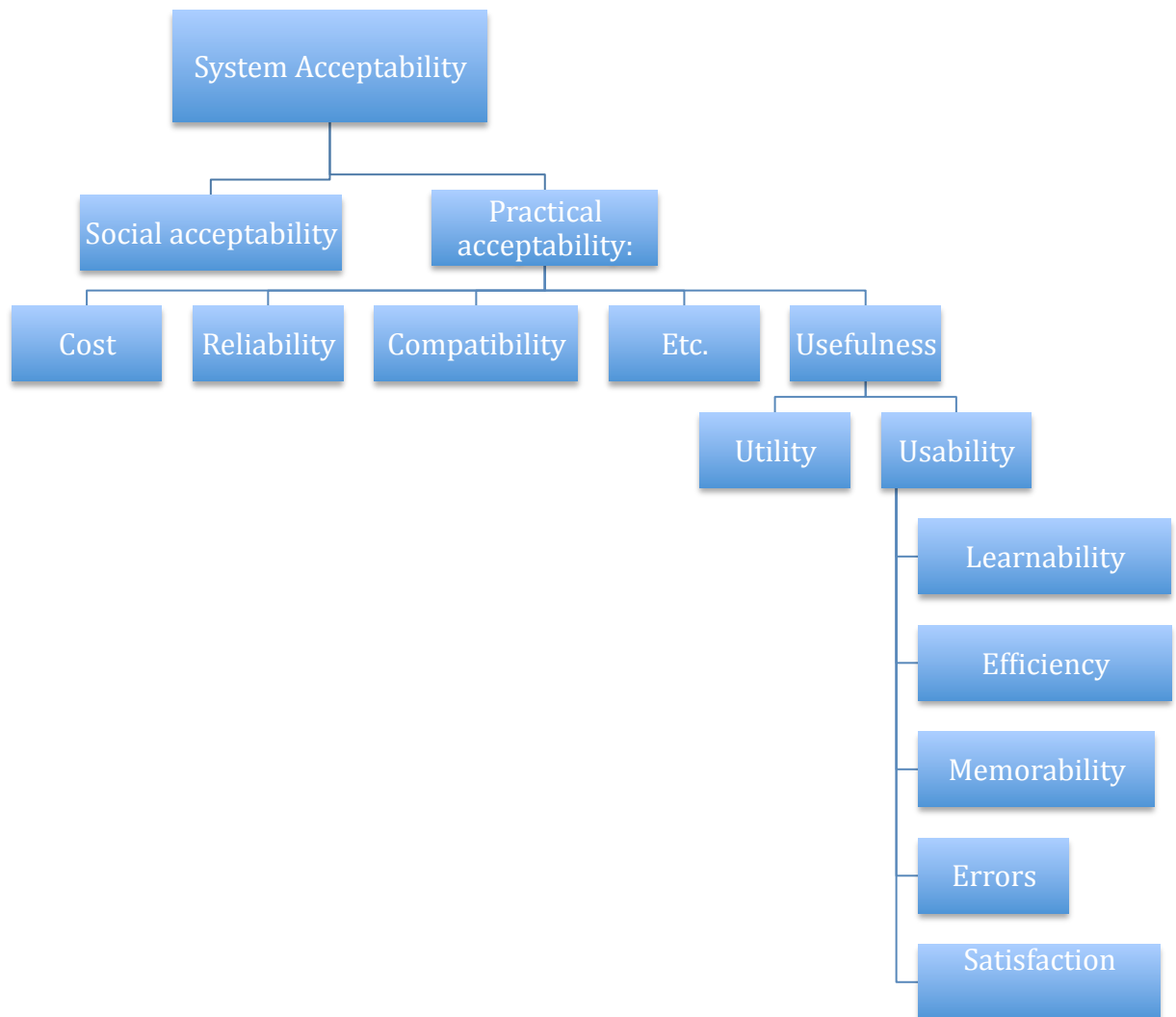


Figure 5. The context of usability in general, J.Nielson (1993, p25).

According to Nielsen, system acceptability is ability of the system to meet all stakeholders' requirements and combination of social and practical acceptability. Social acceptability includes social rules and norms that influence adoption of the system. Practical acceptability refers to practical aspects of system adoption such as cost, reliability, compatibility, usefulness and etc. Usefulness indicates how suitable system is for archiving desired goals, it consists of utility and usability. Utility is ability of the system to do what is needed. The main characteristics of usability according to Nielsen are: learnability , efficiency, memorability, few errors and satisfaction.

Learnability shows how easy system is to learn for the user can start task performance. Systems, easy to learn usually characterized as intuitive.

Efficiency shows how productive system is ones user has learned how to use it. Learnability and efficiency can be conflicting, this is possible when system has hints to help user to learn the features but in case of advanced user such a help just slow down the processes and thus efficiency. To overcome such a conflict, “novice” and “expert” modes can be offered by the system.

Memorability shows how easy system is to remember. It also describes ability of users to relearn how to use the system after period of inactivity.

Errors shows error rate during the use of the system and how easily users can recover from errors. Undo function is recommended to enable user to fix wrong action easily.

Satisfaction shows how pleasant is system to use and how users are satisfied with it.

The author stresses that during the last years there were significant shift towards “pleasure-based” human factors. Sensorial and aesthetic characteristics of the system are extremely important especially in case of information technology product or system. Nowadays “pleasure” of using the system has much greater effect on usability, users want to enjoy using the system and want to fulfill the most of their expectations. Previously good design was focused on user’s physical capabilities to operate it, nowadays wider lifestyle issues has direct impact on the product or system development.

Green and Jordan (2002) recommended following approach to enhance usability of the product:

1. “Don’t think affordances, think temptation.
2. Don’t think beauty in appearance, think beauty in interaction
3. Don’t think ease of use, think enjoyment of the experience”

This approach illustrates new vision on usability and advocates importance of please based factors in product experience.

It is essential to mention another trend in information technology product usability. Modern users get easily disappointed if they have any difficulties in using product, but from other side are not willing to spend much time to learn about product features in manuals. Previously users could and would adapt what ever was build. Trainings, support and “Help” functions were considered

to be enough. Now within the usability framework, end user became the focus of product development process. In such situation user interface intuitiveness as part of usability becomes critical characteristic. Intuitiveness is a synonym to learnability and describes ability of a user to operate a system without prior learning how to use it.

The author stresses here, that usability of user interface is a fundamental aspect of product characteristics and one of the most important factors in a software product success. Nowadays usability is marketable as benefits of increasing usability far exceeding the costs. Usability can drive sales, just like in Apple's case. When iPhone came to the market, smartphone's price level has risen 2-3 times compared to an average price.

According to Hayne (1996): "It takes time to produce good, usable software just as it takes time to produce good food. The comparison with fast-food restaurants might imply that standardized software is more amenable to process and predictability gourmet quality software demands a skilled chef who is given sufficient time. It's usually worth the wait."

In this study usability is interactive characteristic that describes user experience in performing a task with a system and feelings about the process. It describes how system is easy to use and learn, easy to remember and pleasant to use from users point of view.

Based on all stated above, usability is one of the most important characteristics of information technology product.

3.2 USABILITY APPROACHES IN DIFFERENT PRODUCT DESIGN PHILOSOPHIES

Making products or systems more usable is a challenging task as users are different as well as their requirements and preferences. Different approaches to usability in product development referred to different design philosophies depending on having in a focus user, user's goals or activities. By the author opinion design philosophy has significant effect on end-product usability. In this

Section the author describes three types of approaches towards user interface design:

- user-centered design
- goal-directed design
- activity-centered design

3.2.1 USER-CENTERED DESIGN (UCD)

User-centered design (UCD) is dominant paradigm nowadays that optimize product by taking into consideration users desires, needs and vision of the product, rather than trying to change users' behavior or preferences. ISO standard of Human-centered design for interactive systems, ISO 9241-210, 2010 identifies following principles of user-centered design:

1. The design is based upon an explicit understanding of users, tasks and environments.
2. Users are involved throughout design and development.
3. The design is driven and refined by user-centered evaluation.
4. The process is iterative.
5. The design addresses the whole user experience.
6. The design team includes multidisciplinary skills and perspectives.

The main focus of User-centered design is a human user, system should be designed in a way that it supports users' needs and behaviors.

UCD includes different techniques and methods, which are applied on different product's development lifecycle. According to SAP, leading corporation in UCD development tools, the context of UCD development might be illustrated as below.

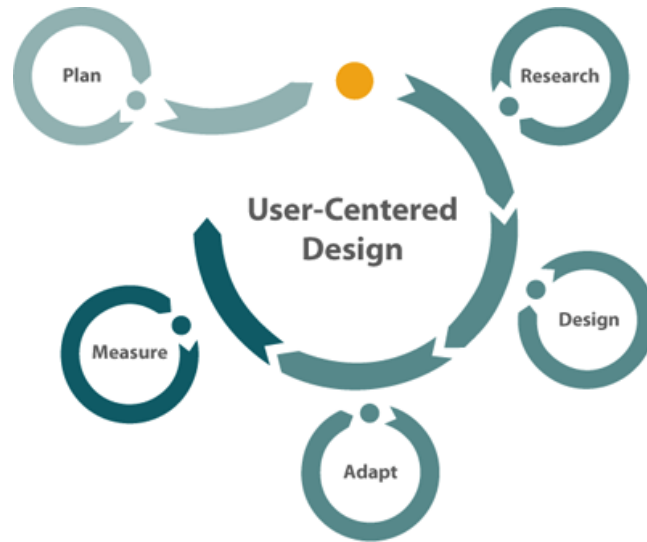


Figure 6. SAP User-Centered Design in the context of SAP development.

Product development begins with a vision of a product and the users for that product. Usability of the product is always referred to the target user group, so targeted users and their needs identification is focus of initial iterative user research.

The main stages of software product development are: planning; research to enable understanding of users' needs; design defines product from users' perspective; adaption based on technology limitations, new requirements etc.; measurement of usability by usability testing or usability inspection methods.

3.2.2 GOAL-DIRECTED DESIGN (GDD)

Cooper (2004) advocates goal-directed design, which also belongs to user-centered methodology. Cooper is supporting his approach as following: "There is a big difference between listening to and following your customers. Listening is good. It means applying your own filter to what you have heard. Following is bad. It means merely doing what your customers tell you to do. This lets the tiger decide where you will go."

Different users express different needs and desires, so following every/many different users desires may lead to the situation when product or system will satisfy nobody. Following and trying to fulfill users' goals instead bring very different and better solutions. Cooper is mentioning that software product shall fulfill broad goals, in his book calls as "persona's goal" such as:

not feel stupid, not make mistakes, get an adequate amount of work done etc. Goals are set at the investigation stage, before development or even design begins. Investigation stage is the most important phase as it includes research and modeling for archetypical users called personas.

3.2.3 ACTIVITY-CENTERED DESIGN (ACD)

Activity-centered design (ACD) is based on activity theory and has activity-centered perspective, so-called “big picture” of common activities users perform with system or product. The focus in such approach is not any more on user or it’s goals, but activities in broad sense system should support. Users have different needs, their goals are varied, but common activities are much easier to define. Activity here is the highest level of user performance and consist of tasks, tasks are divided into actions, actions comprised of operations. Norman (2004) supports Activity-centered design and advocates that people are able to adapt to technology and learn how to interact with system, but tools do not adapt to the people.

Application of different design philosophies has a direct effect on usability of software product. UXD is significant research topic but is behind of the scope of the thesis.

3.3 USABILITY AS AN ASPECT OF USER EXPERIENCE

As it was stated in Chapter 3.1 usability is a quality characteristic of interaction between user and a system or product. Usability is one of the aspects of much broader concept of interaction between user and a company: user experience.

Nielson and Norman refer to user experience (UX) as following: ““User experience” encompasses all aspects of the end-user's interaction with the company, its services, and its products.” Based on above mentioned user experience is not only interaction between user and system through user interface (UI), but has much broader meaning and much wider areas of interaction between company and end user.

Figure 7 below, offered by Peter Boersma shapes practice of UXD, an overall design approach that describes how user perceives and interacts with product or system through different channels. The author will treat the term of user

experience design as a synonym to user experience as both terms per se have the same meaning and scope.

This user experience approach was widely accepted by information technology professionals and called “Big information architecture (IA)”.

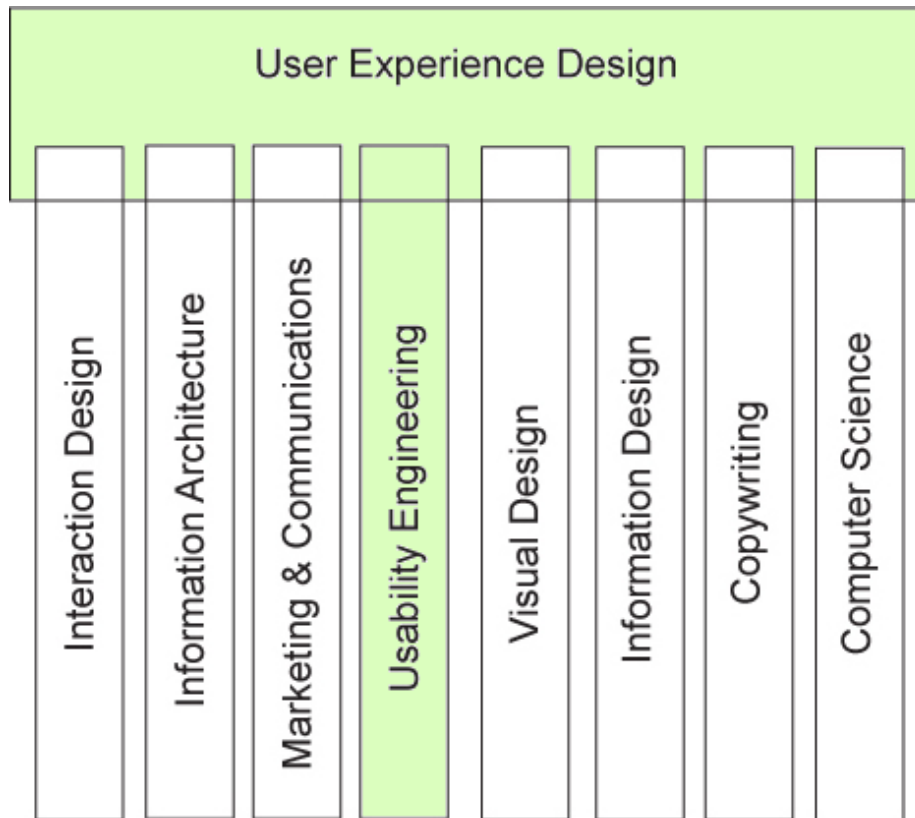


Figure 7. Boersma T-model. Source:

<http://uxmatters.com/mt/archives/2011/10/the-t-model-and-strategies-for-hiring-ia-practitioners-part-1.php>

The purpose of user experience as well as of user experience design is to offer the best experience in terms of overall value, it involves interaction, visual and information design, marketing, copywriting, computer science and usability engineering.

Usability engineering is a part of user experience design and refers to structured approach to building system or product that meets users needs in terms of usability. It requires commitment to understanding and meeting users needs. Usability testing is one of the most common techniques of Usability Engineering as it allows usability evaluation of system or product by testing with real users. Participants of usability testing, real users are interviewed and asked to interact with product or system by completing specific tasks while

Usability Engineer observes their behavior. Methodology and techniques of usability evaluation is discussed later in Chapter 4.

Lahiri (2013) identifies user experience even broader, as a part of strategy and innovation: “If one defines user experience in a narrow and constrained manner as something to do with just the design of a product or service, then that kind of user experience may not actually lead to long-term differentiators. On the other hand, if one defines UX more broadly as the strategy, innovation, and design of compelling, delightful, and persuasive user experiences, then there is bound to be long-term differentiation and success.”

The author fully accepts Marine and Tyne (2011) point of view that user experience objectives are on the same level with business and marketing objectives.

Business objectives are increasing revenue and decreasing costs, marketing objectives are increasing market share and enhancing customers' relationships, user experience objectives shall focus than on managing customer side of the equation and had to be specific and measurable. In such a model business, marketing and user experience objectives will interact and support each other: “Business, marketing, and UX objectives are complementary and support each other. Marketing objectives directly impact UX objectives in that marketing strategy defines target markets, which includes target customers and users of the experience. Moreover, UX objectives help refine the target market. And as much as business objectives guide marketing objectives, they guide UX objectives, too. In many cases, UX objectives refine both business and marketing objectives.”

User experience is broad concept which can not observed fully in this Master's thesis, so the author will concentrate on usability as a part of user experience concept and its approaches.

Karat and Dayton (1995) described usable software as following: "A useable software system is one that supports the effective and efficient completion of tasks in a given work context.”

John Gould and Clayton Lewis in their pioneering paper “Designing for Usability: Key Principles and What Designers Think” proposed Key principles of design that should guide any development process where usability is important: (Gould and Lewis 1985; Gould, Boies et al. 1991):

- **Early Focus on Users.** In-depth understanding who the users are and nature of work to be accomplished via interviews, surveys etc is critical for successful design.
- **Empirical measurement** of a system at the development process via observation, recording and analysis with intended users carrying work with simulators or prototypes. Actual behavioral measurement of usability and learnability.
- **Integrated Design:** there must repeated be cycle of design, testing and measurement.

Above-mentioned principles are still topical and widely used by usability engineers.

3.4 USABILITY EVALUATION METHODS

Usability is usually not noticeable. If something goes well people do not pay attention to it. This brings difficulties to usability evaluation. It is much easier to notice if product is not usable, evaluate and measure it: what difficulties people encounter on the way, what is not clear etc.

Usability evaluation methods in literature are divided into two types of approaches: empirical and inspection methods (Nielsen, 1993; Karat, 1997).

3.4.1 EMPIRICAL USABILITY EVALUATION METHODS.

Empirical usability evaluation methods refer to testing sessions with users and might include following approaches:

- *Think aloud protocol and talk-aloud protocol* are common methods for data gathering. Think-aloud protocol requires users to say whatever they think, feel, do, perform or see. Talk-aloud protocol method involves participants to describe what actions do they perform to complete the tasks. These methods allow researcher to understand user’s logic behind the action and give valuable knowledge of user’s behavior. Disadvantage of these methods are: task performance can be longer due to user’s need to speak about his

or her experience, thus time as task performance evaluation can give not accurate results.

- *Use data collection* enables objective data collection during task performance such as error rate, time needed to perform specific task, time spent for searching source of help information etc. These type of data is easy to analyze and group for the researcher, but data quality can be quite poor, as it doesn't explain user's motives and logic.
- *Questionnaire* is an inexpensive way to collect information from users and include set of questions. Questionnaire may have different forms to gather information such as: standardized answers to be chosen by participant, open questions to enable deeper discussion, ranking to indicate user's preferences and scalar to evaluate participant's opinion regarding specific judgment. Usually questionnaires' data is easy to analyze as it is already structured due to ranking, scaling and grouping answers.
- *Interview* usually refers to qualitative research as Patton (2002) indicated three approaches for conducting an interview:
 - *Informal conversation interview* interviewer relies on the conversation flow and remains open for any possible topics to be discussed. Data is usually rich, but might be unexpected.
 - *General interview guide approach* usually covers predetermined topics but still allows freedom in exploring new areas during the interview
 - *Standardized open-ended interview* include in advance prepared open-ended questions to all interviewees. This type of interview differs from traditional conversation, but allows easier data processing and analysis.

Interviews bring rich data for analysis and unexpected areas can be identified during an interview, but usually data is difficult to structure and analyze. Researcher's bias (own opinion) also has great effect during data analysis stage.

3.4.2 INSPECTION USABILITY EVALUATION METHODS.

Inspection usability evaluation methods are performed by experts and according to Virzi (1997) have following common characteristics: require

limited resources involved, identify usability problems and minimize end-user involvement. Inspection usability evaluation methods include following:

- *Cognitive walkthrough* was designed by Lewis and Polson (1990) and used for testing interactive systems. This method identifies how easy are able to accomplish tasks with the system without formal training. One or group of evaluators are going through specific tasks and evaluate how easy tasks are to be performed. During procedure, evaluator is asking following questions:
 - Will the users try to archive the right effect?
 - Will the user notice that the correct action is available?
 - Will the user associate the correct action with the effect to be archived?
 - If the correct action is performed, will the user see that progress is being made toward solution of the task?
- *Heuristic evaluation* was offered by Nielsen and Molich (1990). Nowadays the mostly common used evaluation was revised and released by Nielsen (1993) and it includes following stages:
 - *“Visibility of system status.* The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.
 - *Match between system and a real world.* The system should speak the user's language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.
 - *User control and freedom.* Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.
 - *Consistency and standards.* Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.
 - *Error prevention.* Even better than good error messages is a careful design which prevents a problem from occurring in the first place.
 - *Recognition rather than recall.* Minimize the user's memory load by making objects, actions, and options visible.

- *Flexibility and efficiency of use.* Accelerators—unseen by the novice user—may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.
 - *Aesthetic and minimalist design.* Dialogues should not contain information, which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.
 - *Help users recognize, diagnose and recover from errors.* Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.
 - *Help and documentation.* Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.”
- *Pluralistic Walkthrough* is applied on early stage of product or system design and used then no other inspection method seems to be suitable (Karat, 1997). Testing is conducted by team of evaluators: representative users, designers, developers and usability professionals. Testing procedure includes primary tasks identification, going through those tasks, identification and exploring system's or product's usability problems. The purpose of conducting testing with team members of different background is to identify usability problems from different perspectives and point of view.
 - *Formal usability inspection* is performed by designers or engineers of the system or product. Usability problems are identified with six logical steps applied. The purpose of this inspection method is evaluation and structuring big amount of usability problems.

In different literature sources (Nielsen, 1994, Karat, 1997 etc.) some other usability inspection methods are mentioned, such as Feature or Standards inspection, but the author supposes that those methods do not relate with the subject of this study.

3.4.2 USABILITY TESTING. USABILITY LABORATORIES VS FIELD STUDIES

Usability testing is commonly used usability evaluation practice by testing product on users. During testing session participants perform certain tasks, which represent common user goals. Time needed and participants' ability to complete tasks together with errors rate is used as metrics. Broadly speaking usability testing is set of empirical evaluation methods widely used for testing software and Internet sites.

The author discusses below different types of setting for conducting usability testing because some were used for case company usability study.

Usability laboratory or usability lab is specifically designed environment, usually one or several rooms set for conducting usability testing. One room accommodates user or users and equipped with video cameras, microphones, video mixers etc. to enable control and observation as user is interacting with a system. Sometimes additional room is used to accommodate observers or inspectors. Figure 6 below illustrates sample setting of usability lab.

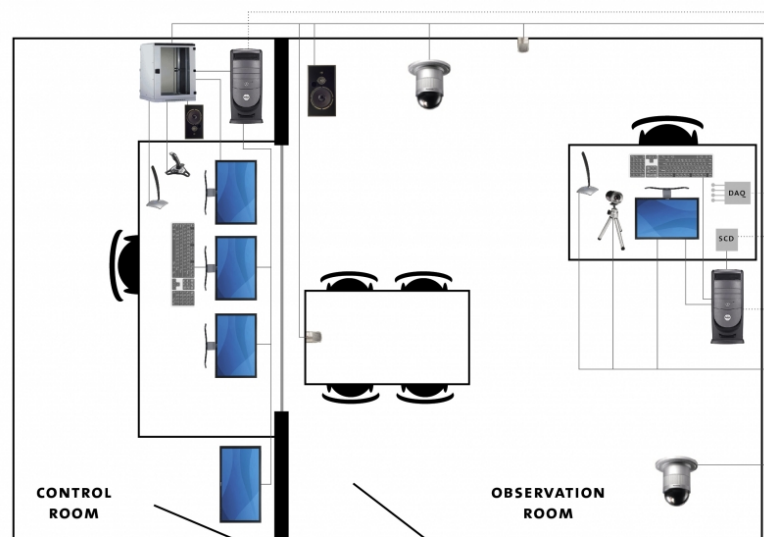


Figure 8. Sample of a usability lab setting.

Source: <http://www.noldus.com/human-behavior-research/solutions/stationary-usability-lab>

Field studies are conducted in the environment that is close to everyday situation for user. As it is almost impossible to avoid disturbance in a real life

situation such as noises, people etc. as users interact with system. Field studies usability testing can be conducted in public places with certain level of noise and disturbance that will imitate real life situation from one side, but from over side enable task performance, interview or conversation between observer and user. In case of field studies, observer must have portable lab setup that may vary depending on testing design.

Table 1 below illustrates comparison of usability labs and field studies for the need of usability testing.

Location	Advantages	Disadvantages
Usability labs	<ul style="list-style-type: none"> - data is directly processed to the computer/central server, that minimizes risk of data loss 	<ul style="list-style-type: none"> - designed only for the testing and requires significant resources - environment is not close to real life situation
Field studies	<ul style="list-style-type: none"> - environment is close to everyday situation for user - does not require significant resources 	<ul style="list-style-type: none"> - during session user might be less concentrated - higher risk of data loss - external disturbance may affect data quality

Table 1. Comparison of usability labs and field studies.

As shown above both environment approaches have advantages and disadvantages, preference of using usability lab of field studies depends on research design, participants availability, observer's resources etc.

3.5 THE THESIS CONCEPTUAL FRAMEWORK FOR THE USABILITY STUDY BASED ON LITERATURE REVIEW

Previous Sections presented the best practices and literature review of the usability concept, its significance in software engineering together with evaluation and approaches methods. This Section indicates the conceptual framework for usability testing in this Thesis.

Based on the best practices and literature review the author created the following conceptual framework that presents the key components of the usability study, Figure 9 below. This framework visualizes relationship between the main concepts that were defined in the objective breakdown by Jolla Ltd, Section 2.1

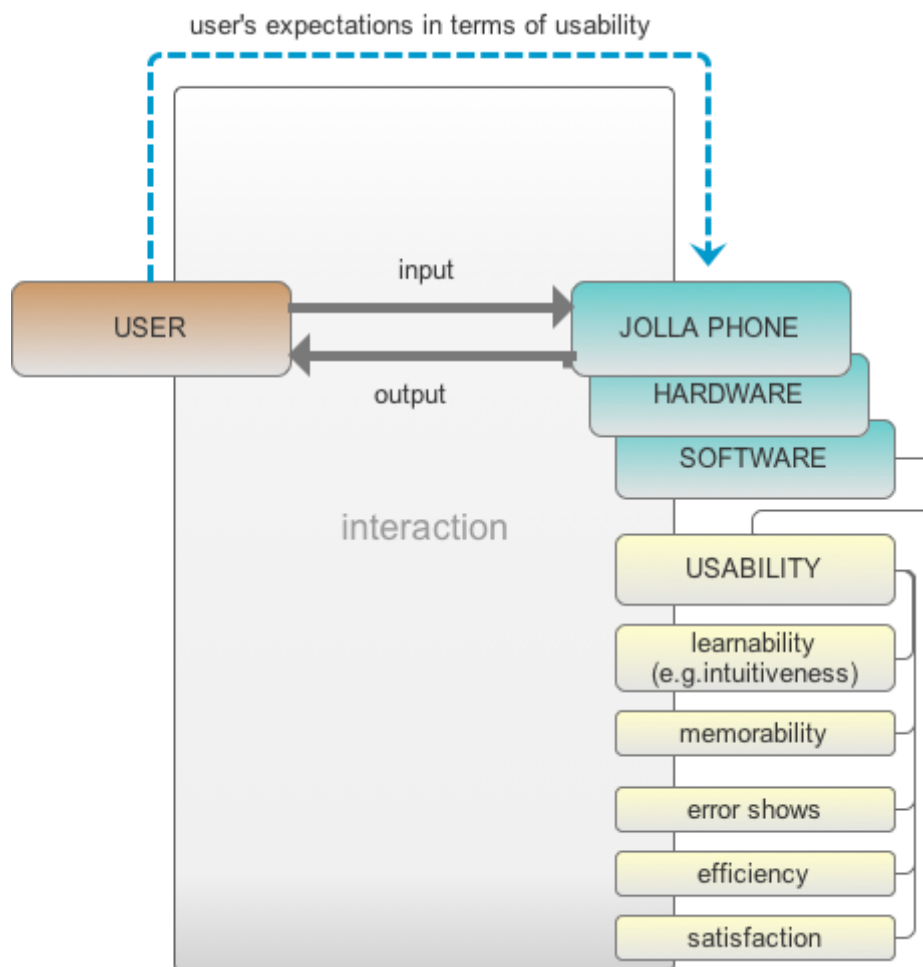


Figure 9. The conceptual framework for the case company usability study.

The conceptual framework above is build based on Nielsen's (1993) definition of usability. According to Nielsen the main characteristics of usability are learnability, efficiency, memorability, few errors and satisfaction.

Empirical usability evaluation methods (Nielsen, 1993; Karat, 1997) were accepted by the author for usability study and included following:

- *Questionnaire* was used for product features evaluation and respondents' preferences and opinions of the product. Ranking of 1 to 5 was applied to enable data processing and grouping based on following.
- *Talk-aloud protocol* enables understanding of user's logic behind the action. Think-aloud protocol was not chosen as it requires also description of user's feelings about interaction process and would lead to longer task performance.
- *Data collection* during task performance such as error rate, time needed to perform specific task, time spent for searching source of help information etc was gathered with the help of video recording. These quantitative data is easy to group and process for further analysis.

The author states that video recording is an effective tool for understanding what kind of obstacles users encounter on the way as they perform tasks. Video recording in this research enabled in-depth analysis as researcher could see recording several times. Video records showed what was confusing for users as they performed their tasks, how long did it take, what gestures users used.

- *Open-ended interview questions* were used at the end of each session to enable unexpected areas of conversation emerge in case it was not covered. Only a few open-ended questions were applied as data is usually reach and difficult for structuring and analysis.

Based on the usability testing overview in Section 3.4.3 field studies method was applied for the case company usability study. As stated above field studies do not require significant resources and provide environment similar to everyday situation for users.

This Chapter discussed concept and context of usability in general, its characteristics and evaluation methods. User experience, the broader concept of usability, and different product design philosophies were also presented by

the author. The Thesis conceptual framework for the case company's usability study was designed based on literature review.

4. THE USABILITY STUDY PROCEDURE AND FINDINGS

4.1 THE DETAILED DESCRIPTION OF CONDUCTED USABILITY STUDY FOR THE CASE COMPANY JOLLA LTD

This Chapter is devoted to practical part of the usability study conducted by the author for the case company Jolla Ltd. Section 4.1 of this Chapter presents the detailed steps of the data collection and testing procedure. The research findings are discussed in Section 4.2.

4.1.1 THE EXTENSIVE RESEARCH OBJECTIVES BREAKDOWN.

The data collection design was based on the research objectives breakdown; minimized version was already presented by the author in Figure 2, Section 2.1. As it was stated above, the author did not work in the case company, so in order to verify clear and detailed understanding of the research objectives and approach, the extensive research objectives breakdown was created and accepted by Tim McDonald, Head of Marketing. The following Figure 10 presents the extensive research objectives breakdown.

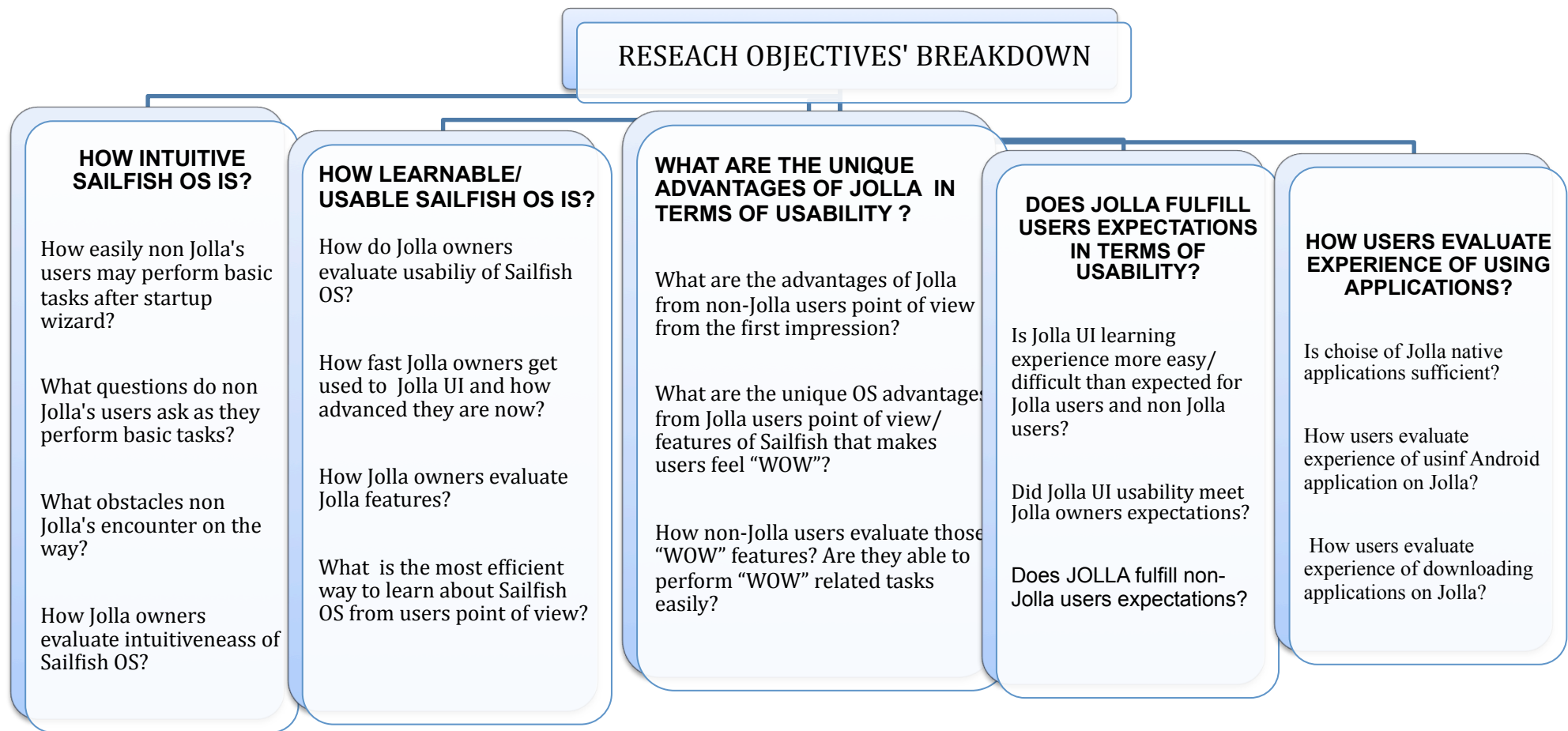


Figure 10. The extensive research objectives' breakdown.

Interview and questionnaire topics together with the list of test tasks were selected based on the above mentioned extensive research objectives' breakdown.

4.1.2 THE DATA COLLECTION DESIGN

The usability study for the case company Jolla Ltd was conducted during one-on-one sessions with one test user at a time. The usability study included interviews, questionnaires and test tasks. The data collection procedure was made in two rounds to enable identification and analysis of the unique advantages of Jolla in terms of usability. Figure 11 below visualizes the data collection design:

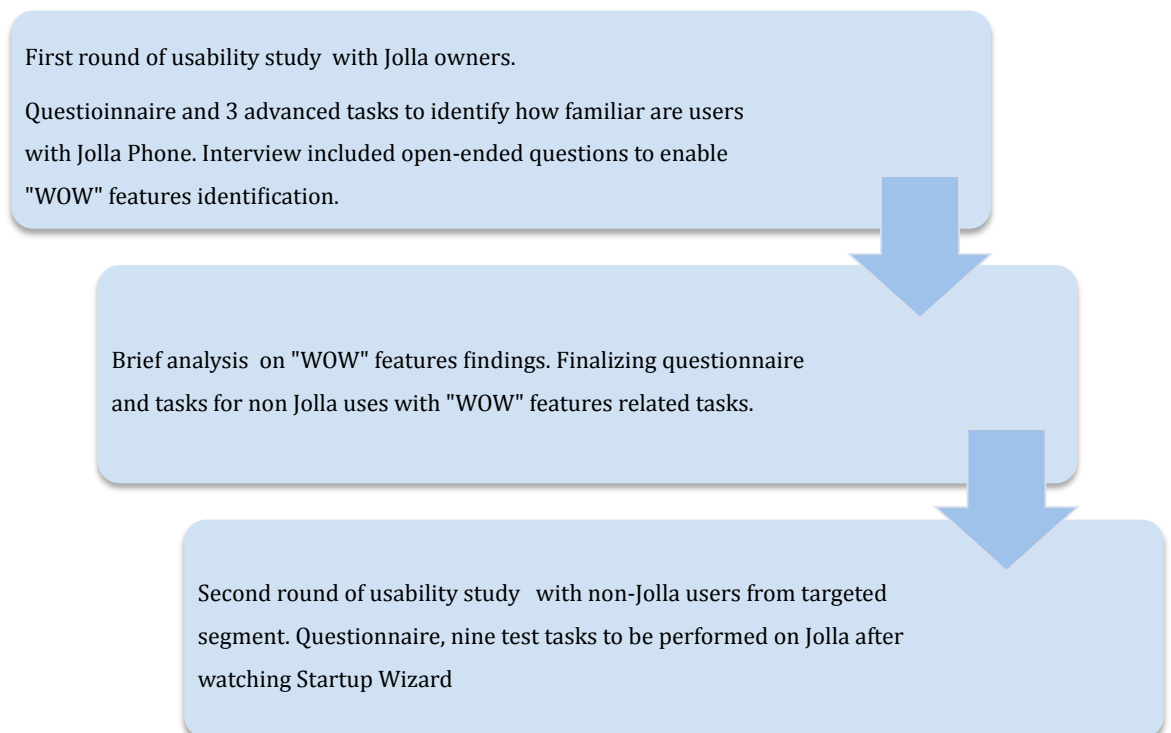


Figure 11. The data collection design for usability study.

First round of usability study was conducted with Jolla owners and included questionnaire, a few advanced tasks to perform on Jolla and a few open-ended questions to identify unique "WOW" related features and advantages.

Brief analysis of first round findings allows finalizing list of “WOW” related features and corrections for questionnaire and interview questions of non-Jolla users.

Second round of usability study was conducted with non-Jolla users from targeted segment and included questionnaire, nine basic tasks to be performed on Jolla after Startup Wizard. Open-ended questions allow evaluation of previously identified “WOW” related features and advantages of Jolla. During task performance participants were able to use official tutorials on YouTube and User Guide in case help was needed.

At the end of each session user comments regarding experience of using Jolla were video recorded by the author.

To enable data collection, ten participants were chosen by the author of this study, based on the following criteria:

- five Jolla owners
- five prospects from target segment

The detailed description for the ground of number of participants for the usability study is discussed in Section 6.2 Validity and Reliability.

4.1.3 SESSION FLOWCHART

Ten sessions were conducted in quiet cafeteria in Helsinki downtown. Duration of each session was a bit over one hour. Tasks performance by Jolla owners and non-Jolla users was recorded with digital video camera to enable deeper analysis of Sailfish OS usability.

As it was stated in Section 3.5 talk-aloud protocol was chosen for the usability study to enable deeper analysis.

The below Figure 12 visualizes the usability study session flowchart:



Figure 12. The usability study session flowchart.

As stated above each session had pre-test questionnaire, tasks to perform on Jolla and post-test questionnaire and open-ended interview questions.

The main objective of non-Jolla users pre-test questionnaire was to discover users' first impressions and opinions about the product. In this case utility and value of the product is evaluated before even considering usability as a factor. It is extremely important for the new products on the market.

4.1.4 THE USABILITY STUDY TECHNIQUES, EVALUATION METHODS AND METRICS.

Another technique used in this research was asking the same questions before and after the test tasks, to see if users opinion has changed after they used Jolla. This helps not only in evaluating overall usability but also provide valuable outcome for marketing team in order to evaluate targeted group of customers.

Several questions lead to understanding if users desire to own Jolla. This is important evaluation for understanding product value from the users' point of view.

The below Table 2 presents the most significant questions for investigation usability of Jolla together with techniques, methods used to enable the data collection and metrics.

QUESTION FOR INVESTIGATION	TECHNIQUES AND EVALUATION METHODS
HOW INTUITIVE JOLLA IS?	Tasks' performance by non-Jolla users after watching startup wizard: <ul style="list-style-type: none"> ▪ error rate among ▪ time needed to complete the task ▪ number of steps required to perform the task ▪ percentage of tasks completed successfully ▪ difficulties non-Jolla users encounter

	<p>during task performance</p> <p>Ranking user experience of managing UI for each specific task by non-Jolla users.</p> <p>Evaluation of Sailfish OS intuitiveness by Jolla owners and non-Jolla users.</p>
<p>HOW LEARNABLE JOLLA IS?</p>	<p>Advanced tasks' performance by Jolla owners:</p> <ul style="list-style-type: none"> ▪ Error rate ▪ time needed to complete the task ▪ percentage of tasks completed ▪ number of omitted steps. <p>Ranking user experience of managing UI by Jolla owners.</p> <p>Difficulties Jolla owners encounter on the way.</p>
<p>WHAT IS THE PRODUCT VALUE OF JOLLA?</p>	<p>Sailfish UI features ranking by non-Jolla users:</p> <ul style="list-style-type: none"> ▪ before task performance on Jolla ▪ after task performance on Jolla <p>Sailfish UI features ranking by Jolla owners.</p> <p>Evaluation of Jolla's features by non-Jolla users based on first impression.</p>
<p>WHAT IS THE MOST EFFICIENT WAY TO LEARN ABOUT JOLLA'S FEATURES FROM USERS POINT OF VIEW?</p>	<p>Different sources of information ranking e.g. tutorials, user guide etc. by Jolla owners and non-Jolla users.</p> <p>Researcher's observation on information sources used during task performance by non-Jolla users.</p>

	<p>Jolla owners opinion about the most efficient way to learn about Sailfish UI.</p>
<p>WHAT ARE THE UNIQUE ADVANTAGES OF JOLLA?</p>	<p>Jolla owners opinions regarding unique “WOW features” of Jolla.</p> <p>Non-Jolla users evaluation of unique “WOW features” of Jolla.</p>
<p>WHAT ARE THE EXPECTATIONS OF SAILFISH OS IN TERMS OF USABILITY AND HOW WELL SAILFISH OS FULFILLS USERS EXPECTATIONS?</p>	<p>Jolla owners expectations of Sailfish OS usability before the purchase, based on multiple choice in questionnaire.</p> <p>Ranking expectations of ease to use Sailfish OS:</p> <ul style="list-style-type: none"> ▪ before and after task performance by non-Jolla users ▪ Jolla owners
<p>HOW USERS EVALUATE EXPERIENCE OF USING APPLICATIONS?</p>	<p>Choice of application ranking by Jolla owners.</p> <p>Number of applications Jolla owners and non-Jolla users</p> <ul style="list-style-type: none"> ▪ currently have ▪ use daily. <p>“Must have” applications for Jolla owners and non-Jolla users.</p> <p>Number of Android applications Jolla owners have installed.</p> <p>Difficulties, Jolla owners encounter on the way by using Android applications on Jolla.</p> <p>Ranking of application installation</p>

	experience by non-Jolla users.
--	--------------------------------

Table 2. Questions for usability study investigation together with techniques, methods used to enable data collection and metrics.

4.2 THE USABILITY STUDY FINDINGS

As it was stated in Section 4.1.2 the usability study for the case company Jolla Ltd. was conducted in two rounds: first round with Jolla owners, second round with non-Jolla users. Each one-on-one session consisted of questionnaire, tasks to be performed on Jolla and interview. Session design for each group of participants (Jolla owners, non-Jolla users) was different and included different questionnaires, tasks and open-ended interview questions.

Based on completed questionnaires, findings were structured by the author in two Excel tables of about 100 lines each and included users ratings, answers, comments and marks if tests were completed. Research findings are confidential information and a property of Jolla Ltd. It is included into Master's Thesis Appendixes 3 and 4 and not available for publishing. It may be obtained from the author by Jolla Ltd. permission.

Almost seven hours of video recording of task performance by Jolla owners and non-Jolla users gave rich data for analysis. The author went through all records and marked participants comments on features users liked and difficulties encountered on the way. List of users' comments regarding their experience of using Jolla is given in Appendix 5.

More detailed analysis of non-Jolla users task performance is possible by comparison of Sailfish OS logic model with steps participants made to perform the tasks. Such an analysis could give valuable information what might be unclear for the new users in managing UI and which hints might help to get desired outcome or what changes needed to make Sailfish OS more intuitive. The author did not have available resources for such an analysis, thus all video records were given to Jolla Ltd. to enable deep understanding of user experience in managing UI.

5. THE RESEARCH FINDINGS ANALYSIS AND THE THESIS PROPOSALS FOR THE CASE COMPANY JOLLA LTD.

5.1 ANALYSIS OF THE JOLLA OWNERS RESEARCH FINDINGS.

All five Jolla owners purchased their smartphones during December 2013 from Jolla website or DNA store. Four out of five participants previously owned Nokia smartphone and three liked MeeGo products or wanted to support Finnish manufacturer. This shows strong connection of Jolla with Nokia products and indicates that majority of participants at the stage of making decision about the next purchase referred to quality of MeeGo products.

The study findings showed that Jolla owners regularly update new OS releases: all five participants had the latest OS version (released just a few days ago) and mentioned that they upgrade Sailfish OS monthly.

Four participants answered that Jolla is the only smartphone they currently use.

5.1.1 JOLLA'S INSIGHTS AND FEATURES EVALUATION.

Answering the question "What will be your next smartphone?" two participants mentioned that it will be Jolla, one mentioned "something that runs Sailfish OS". This is a very important factor that shows overall users satisfaction of Jolla.

The below Figures 14 - 22 present the Jolla features ranked by the Jolla owners. Users evaluated features from one to five, where five is the maximum score.

Jolla's features evaluation by Jolla owners by ranking from one to five, where five is maximum value (part 1).

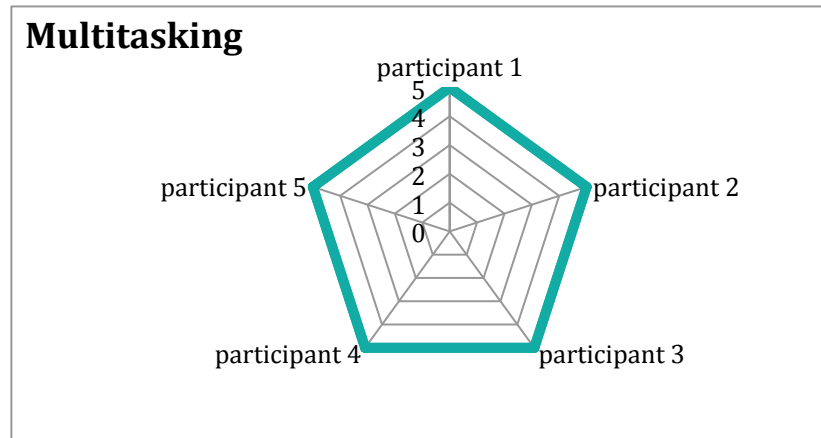


Figure 14. Multitasking.

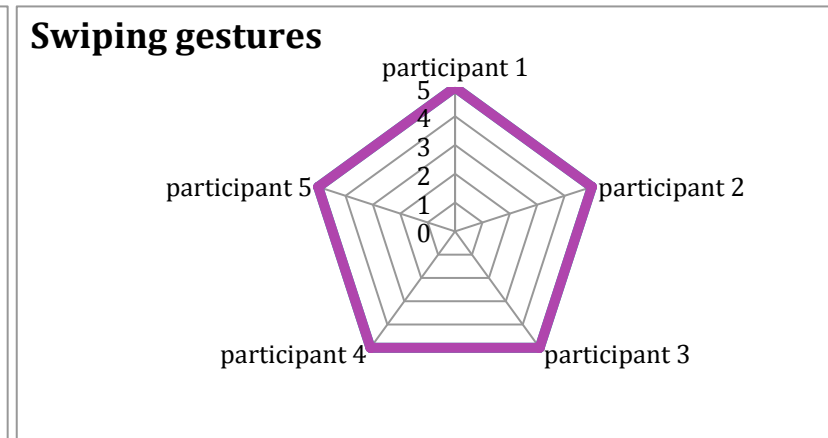


Figure 15. Gestures

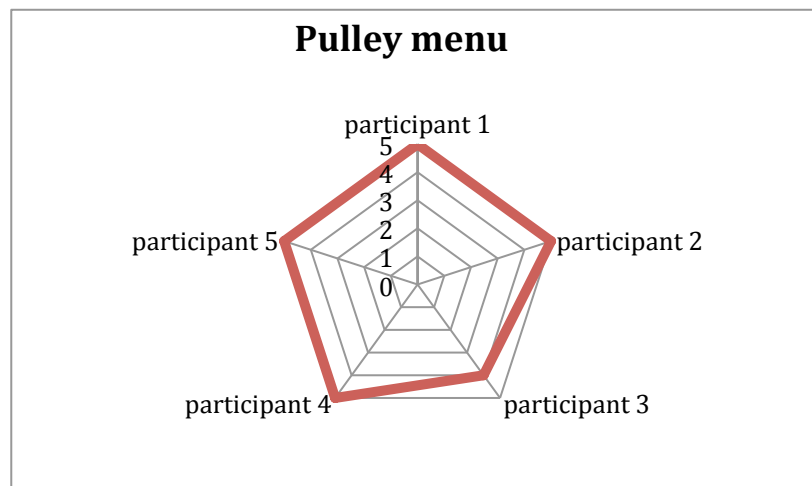


Figure 16. Pulley menu.

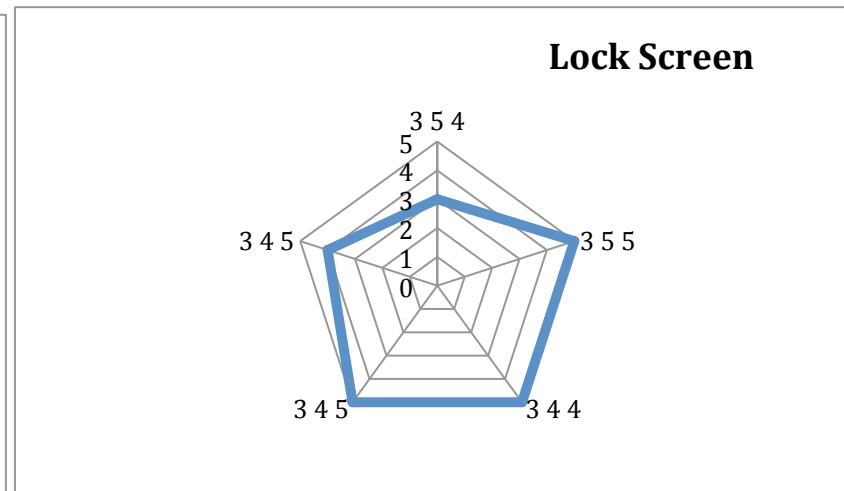


Figure 17. Lock Screen.

Jolla's features evaluation by Jolla owners by ranking from one to five, where five is maximum value (part 2).

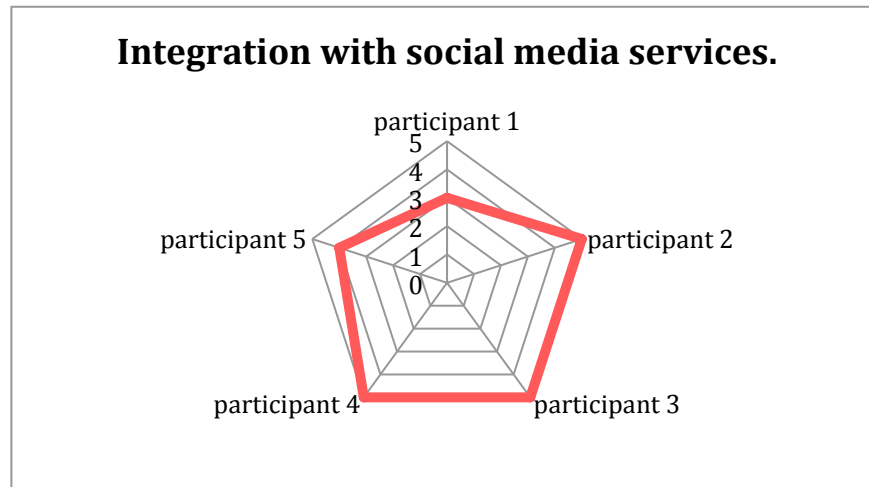


Figure 18. Integration with social media services.

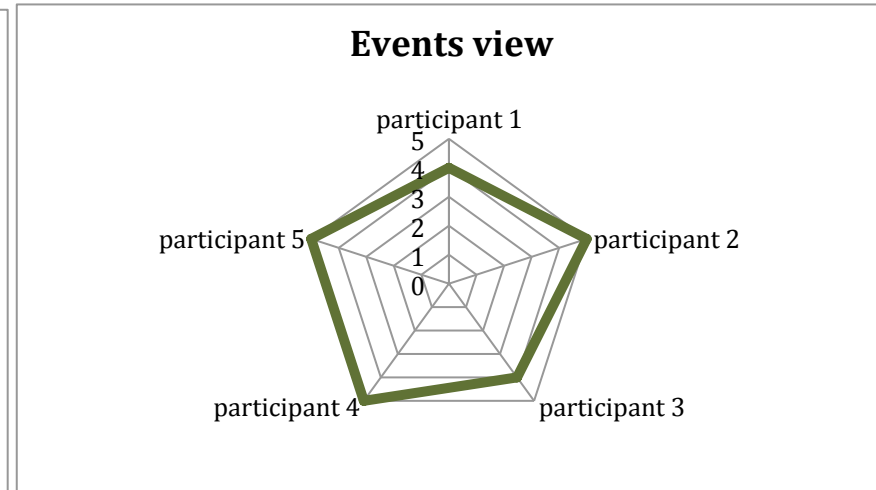


Figure 19. Events view ranking.

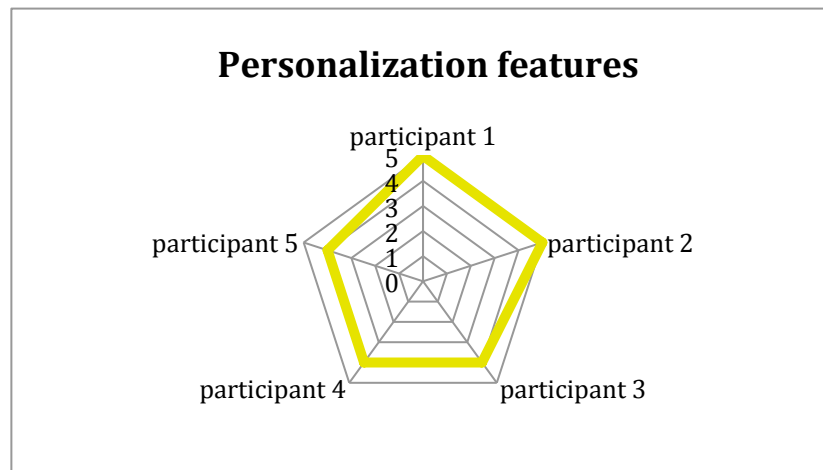


Figure 20. Personalization features ranking.

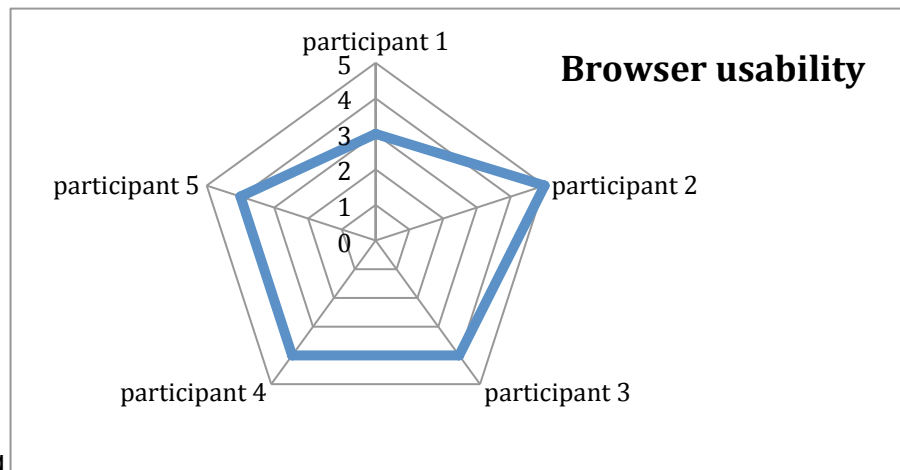


Figure 21. Browser usability.

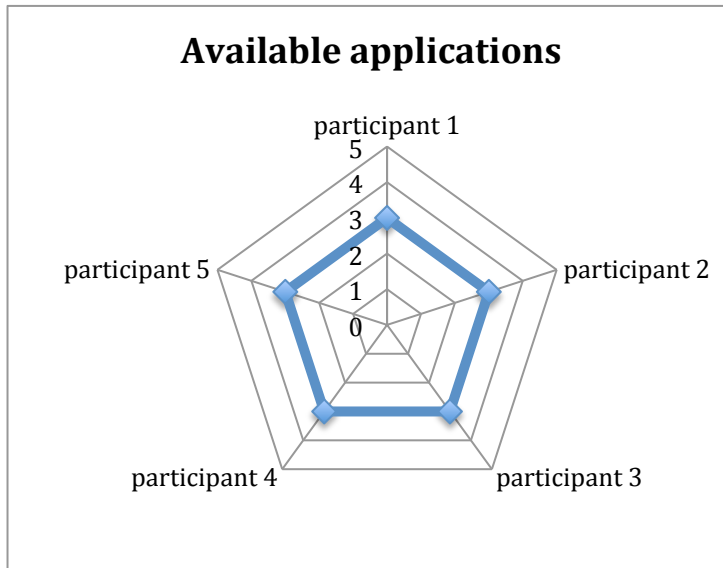


Figure 22. Evaluation of applications availability by Jolla owners by ranking from one to five, where five is maximum score.

Figures above illustrate evaluation of the product insights from users with experience in managing Sailfish OS. Based on the research findings gestures, multitasking and pulley menu are the highest evaluated Sailfish OS features. Additionally, three participants mentioned gestures as “WOW” feature and two users mentioned multitasking. The author decided to accept swipe gestures and multitasking as “WOW” related features and interview non-Jolla about their opinion on these unique features.

Browser usability and available applications had the lowest score that shows that there is a room for improvement. The detailed comments of Jolla owners regarding these features are listed in Appendix 5.

Another area that risen questions from Jolla users is synchronization (phone book, push email, via WebDav, Outlook contacts). Two out of five users answered that they still have questions about Sailfish OS and both questions were about synchronization.

Specific gestures evaluation (top down swipe, events view swipe, one click dial number).

Three of five participants knew that that top down swipe and one click dialling are optional features, but still three Jolla owners mentioned that it would be good to have notification that it is optional.

One click dial number was ranked by highest score only by one Jolla owner. Three participants turned off **one click dial number** and two mentioned that this feature enables accidental dialling.

Top down swipe was ranked higher than one click dial number, one participant told that this gesture is impossible to be performed by one hand.

Events view swipe was ranked lower than four only by one participant, who complained that when Android application is opened, this swipe sometimes does not perform. One Jolla owner and one non-Jolla user mentioned that this gesture could be confused with down up swipe.

Figure 23 below represents the Jolla-owners ranking of the above-mentioned features from one to five, where five is maximum value. In case participant did not know about the feature, it was ranked with zero.

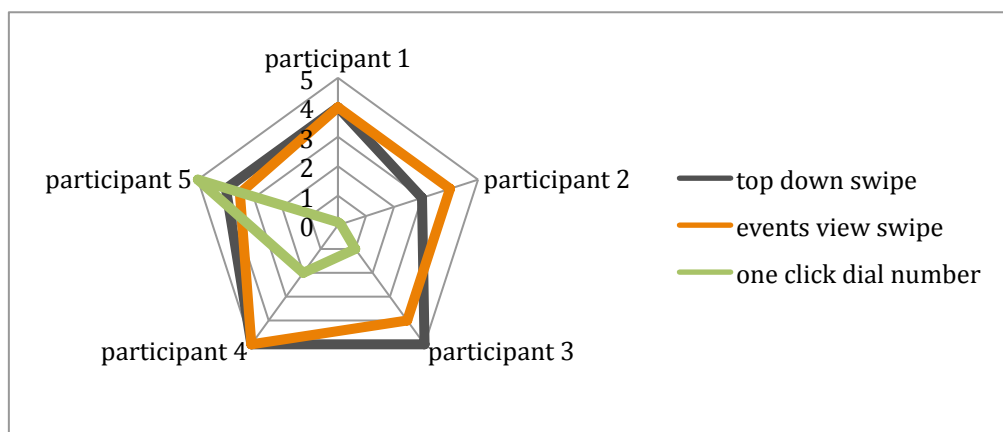


Figure 23 Top down swipe, events view swipe, one click dial number evaluation by Jolla owners by ranking from one to five, where five is maximum score.

5.1.2 USABILITY, LEARNABILITY AND INTUITIVENESS OF SAILFISH OS.

Learnability. All five participants completed advanced tasks and commented that it was an easy experience. “A bit difficult” for two of them was performing task with calendar, as those users did not use Jolla’s native calendar.

Three Jolla owners told that they think they have learned all Jolla features, two others told they did not and the same two did not know about one click

dialing feature. Three of five participants mentioned that they did not have any questions about Jolla's features.

None of the Jolla owners mentioned that User Guide was used to learn about Jolla features and none of them recommended it. Based on research findings learning by using and tutorials on You Tube are the most effective way to learn about features. One participant used 3rd party's video on You Tube.

Start up wizard was mentioned ones as a tool to learn about Jolla's gestures; two participants complained that swipe hints are annoying for experienced users.

Even though all participants ranked gestures with the top score, following gestures were mentioned as confusing during the learning curve:

- Down up swipe and events swipe were confusing (as motion in both cases starts from the bottom)
- Browsing photos and managing those by horizontal gesture

Intuitiveness. Four participants ranked intuitiveness of Sailfish OS with maximum score five, one participant gave a score of four. Figure 24 below represents intuitiveness rating by Jolla owners

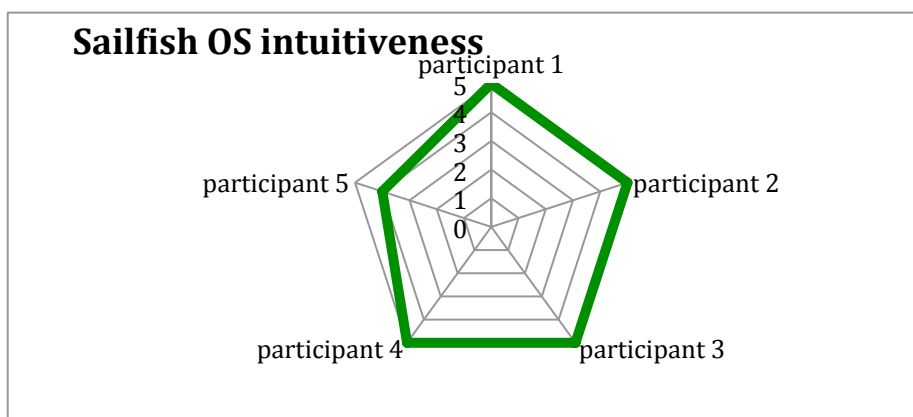


Figure 24. Evaluation of Sailfish OS intuitiveness by Jolla owners with ranking from one to five, where five is maximum score.

That shows that users operate UI naturally, ones they learn about features.

5.1.3 SMARTPHONE OWNERS EXPECTATIONS OF JOLLA AND ITS USABILITY.

Users are interested in new and innovative products, four participants mentioned that their expectation from Jolla was “cool&different”. Another listed reasons to purchase Jolla were: wanted open source OS & was bored of Android; liked “The new beginning” trailer. Figure 25 below illustrates users expectations of Jolla at the moment of purchasing it.

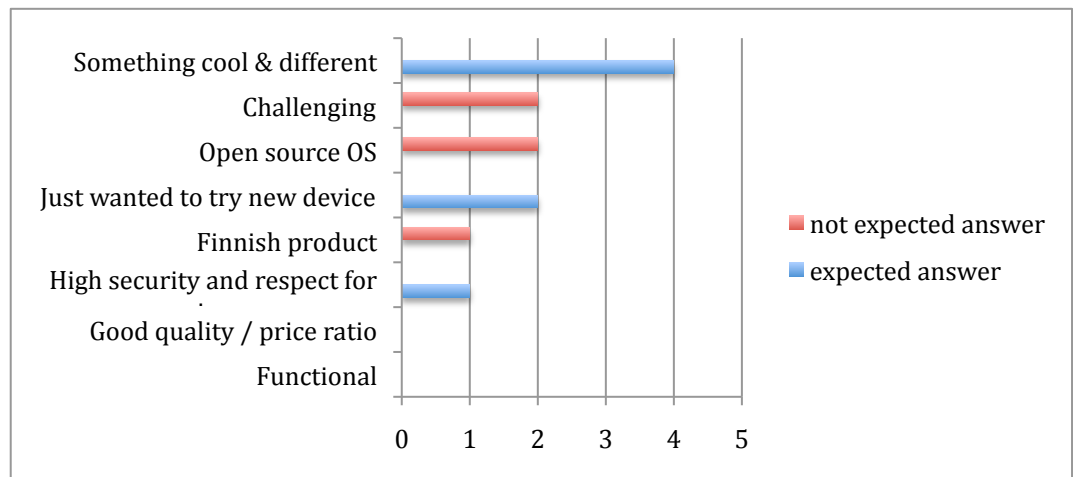


Figure 25. Expectation of Jolla owners at the stage of purchasing.

Figure below illustrates Jolla-owners expectations in terms of usability and in terms of learnability. Ranking from one to five was based on following principle:

1= much more difficult than expected

2= more difficult than expected

3=as expected

4= easier than expected

5=much more easy than expected

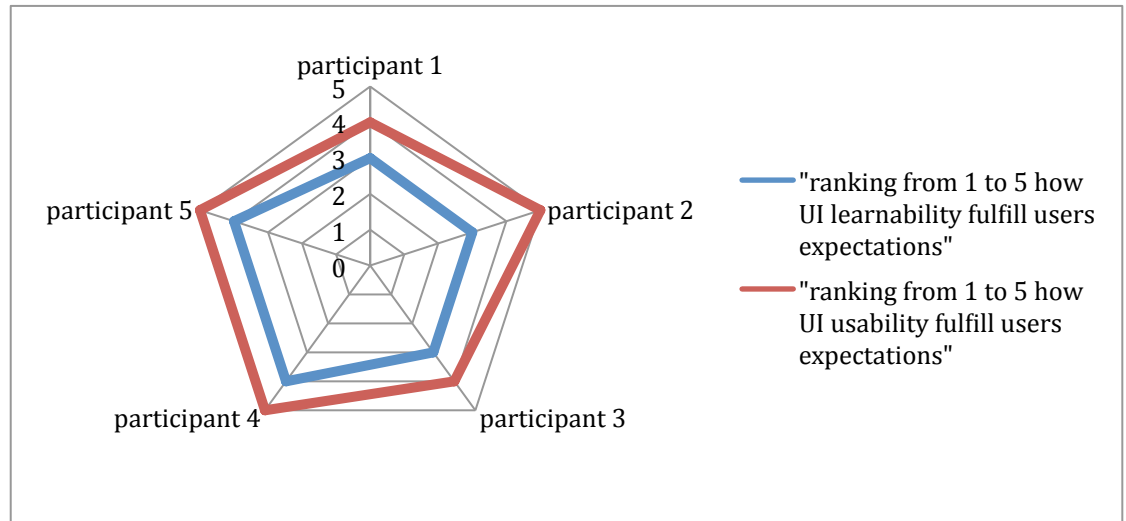


Figure 26. Evaluation how Sailfish OS met users expectations in terms of usability and learnability by ranking from one to five, where five is maximum score.

The figure above shows that according to experience of Jolla owners, usability of Sailfish OS was much higher than expected; three participants marked it with maximum score. Learnability of Sailfish OS was as expected for three participants and easier than expected for two participants.

This shows that Jolla's usability exceeded users expectations. On the author point of view it illustrates also importance of effective learning tools for users.

5.1.4 EXPERIENCE OF USING APPLICATIONS.

Average number of applications Jolla-owners had installed on their smartphone was forty-two, average number of applications in daily use was eight. The author believes that number of applications in use might be even higher, as some of the basic applications, for example clock etc. could not be taken into account. The most often mentioned applications were: Mail, Facebook, WhatsUp, Instagram, Twitter and Calendar. Testing session showed that two of five participants do not use Jolla's native calendar.

All five participants stated that downloading applications was very easy, but the choice of native applications is not sufficient. All participants were able to find and install their Android "must have" apps, but experience in using Android applications on Jolla has room for improvement. Detailed description

of Jolla-owners comments regarding their experience of using Android application is given in Appendix 5. Figure 27 below illustrates user experience evaluation in ranking from one to five of downloading applications and use of Android application on Jolla.

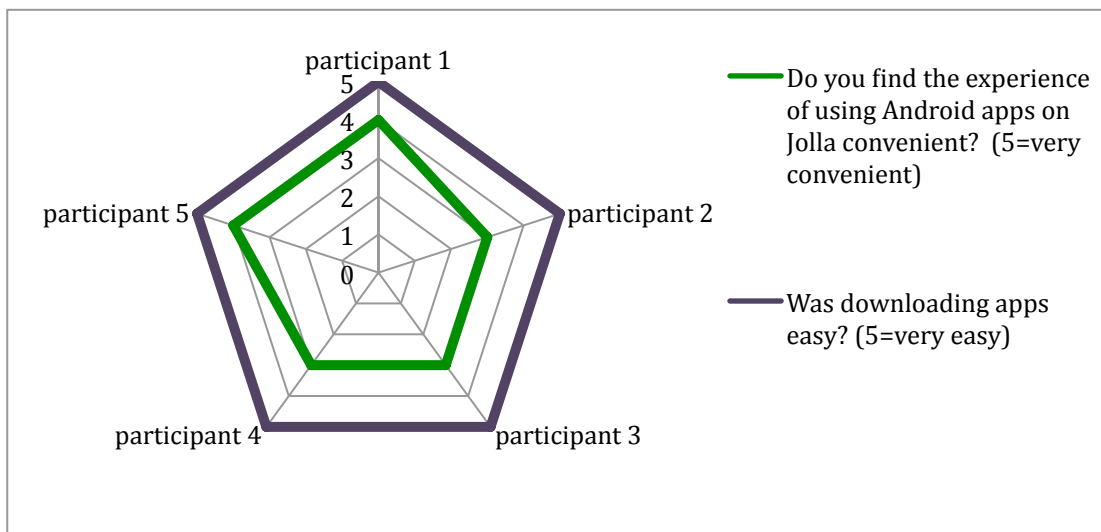


Figure 27. Jolla-owners downloading and using Android apps experience evaluation by ranking from one to five, where five is very easy.

Four of five users did not want to have more preinstalled applications, one participant answered that he would like to have Clock preinstalled.

5.2 ANALYSIS OF NON-JOLLA USERS RESEARCH FINDINGS.

Five participants from the target group interested in Jolla were tested in category of non-Jolla users. Four users had Android phone, one had Nokia Lumia as a current smatrphone.

5.2.1 SMARTPHONE FEATURES IMPORTANCE AND JOLLA'S INSIGHTS EVALUATION.

All five users mentioned following daily actions their perform on their smartphones: phone calls, Internet browsing, messaging, using email.

Four users mentioned instant messaging as an action performed daily. At the same time, two of them commented that keyboard is comfortable and easy to

use. Alphabet order in organizing contacts was also mentioned by two participants as an advantage.

Figure 28 below represents smartphone features evaluation by non-Jolla users.

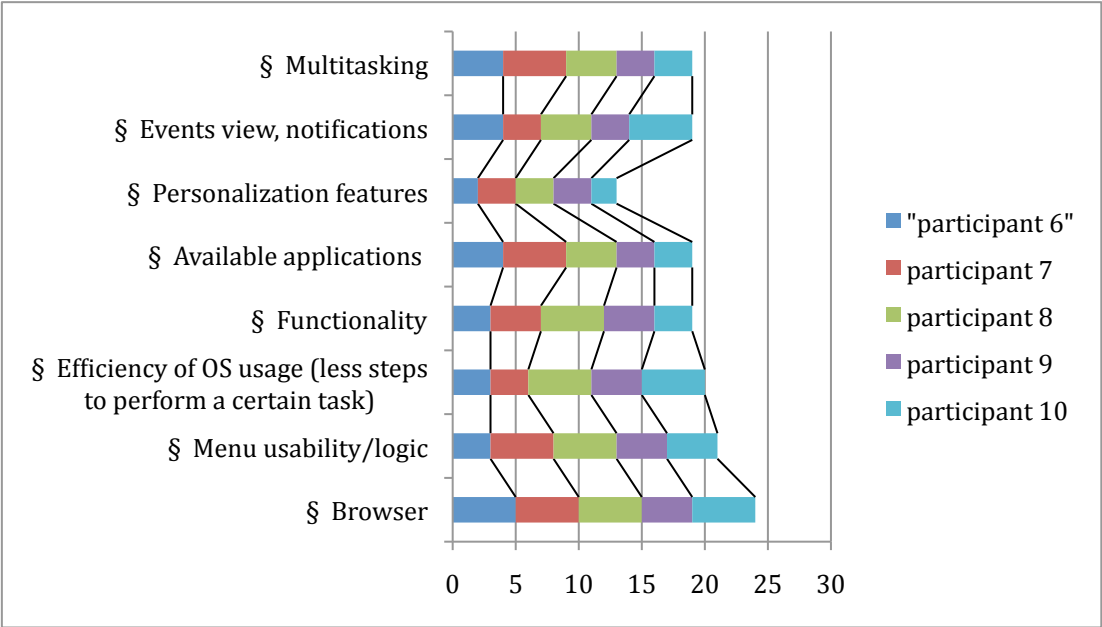


Figure 28. Smartphone features evaluation by non-Jolla users.

Browser, menu usability and logic together with efficiency of OS usage were evaluated as the most important features of UI.

Figure 29 below illustrates ranking of the usability and logic of Sailfish UI by non-Jolla users and importance of UI usability and logic.

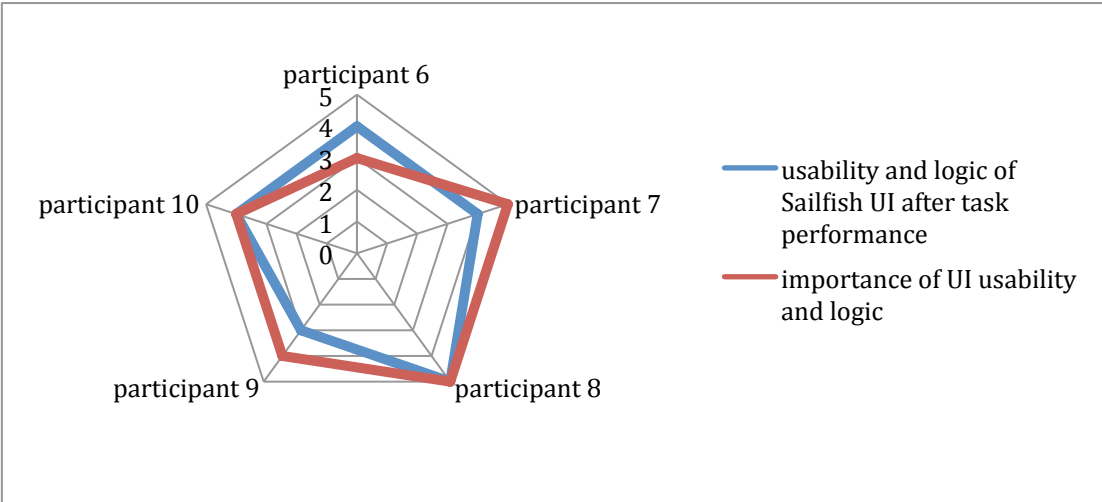


Figure 29. Non-Jolla users evaluation of the Sailfish UI usability and its importance by ranking from one to five, where five is very important.

Usability and logic of UI was ranked with the highest score by two non-Jolla users, three other users evaluated it as middle-high importance feature.

One user after testing told that he wants to buy Jolla and another wanted to download OS, as smartphone price range is over his budget.

Figures 30 – 32 below represent evaluation of the Jolla smartphone features by non-Jolla users.

Jolla's first impression evaluation by non-Jolla users by ranking from one to five, where five is maximum value.

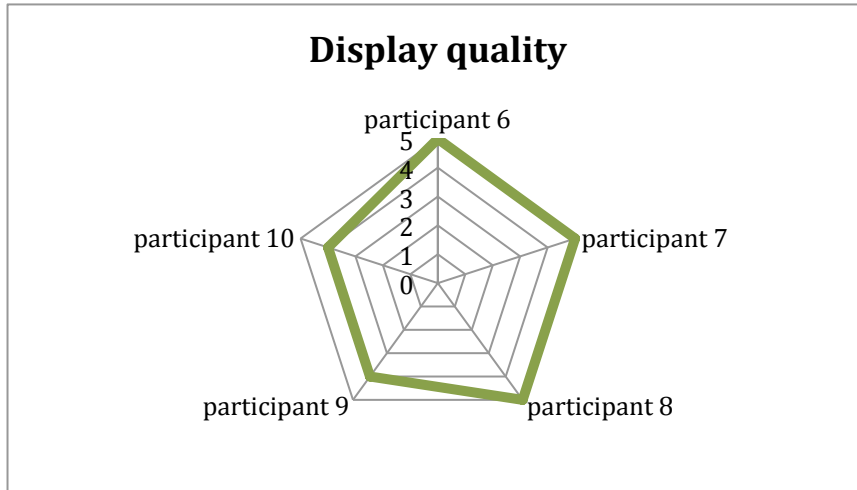


Figure 30. Display quality.

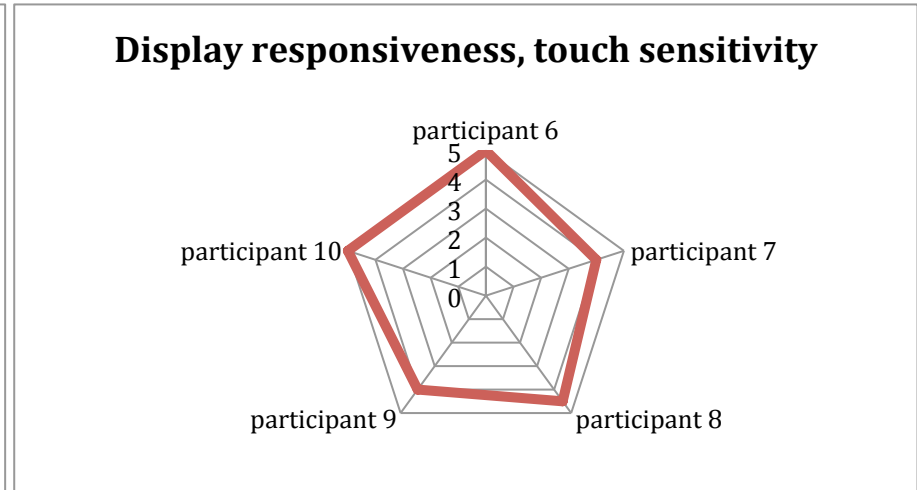


Figure 31. Display responsiveness, touch sensitivity

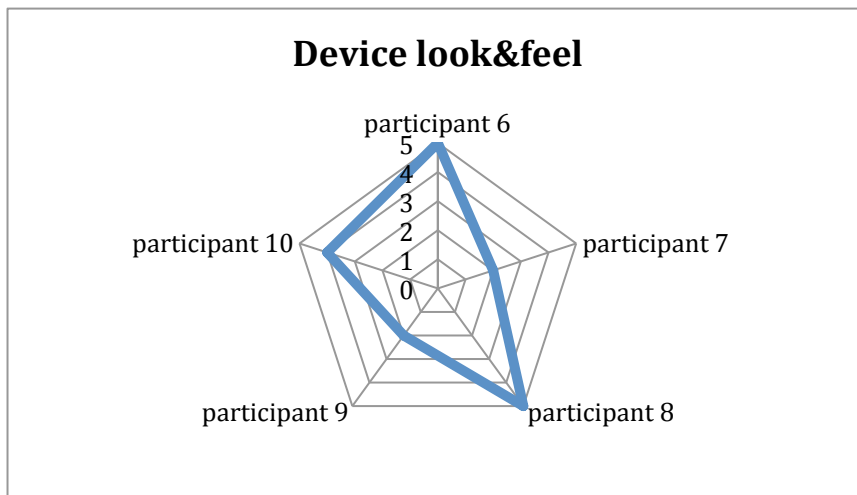


Figure 32. Device look&feel.

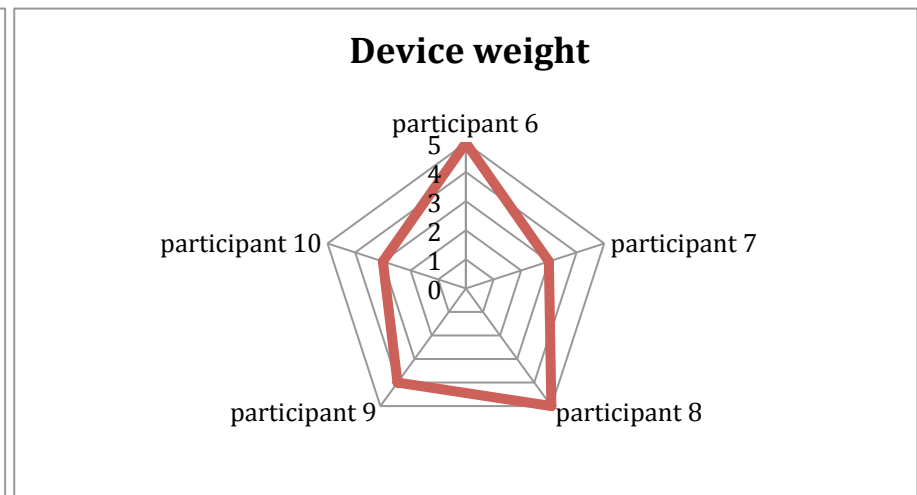


Figure 32. . Device weight.

Jolla's display quality, responsiveness and touch sensitivity was highly evaluated by non-Jolla users. "Device look & feel" was not equally ranked, as two users did not like the other half. Two participants evaluated weight of Jolla with highest score; three users told that smartphone could be lighter.

5.2.2 USABILITY, LEARNABILITY AND INTUITIVENESS OF SAILFISH OS.

Non-Jolla users performed nine tasks on Jolla after going through startup wizard.

After each task participants were asked to comment how easy for them was to perform the task and rank their experience from one to five, where five is maximum score. In case user was not able to perform the task it was ranked with zero.

Figure 33 below shows result of task evaluation by ranking for one to five where five is maximum score. X-axis is the total score amount, thus maximum value represents that task was easy for the most of the users.

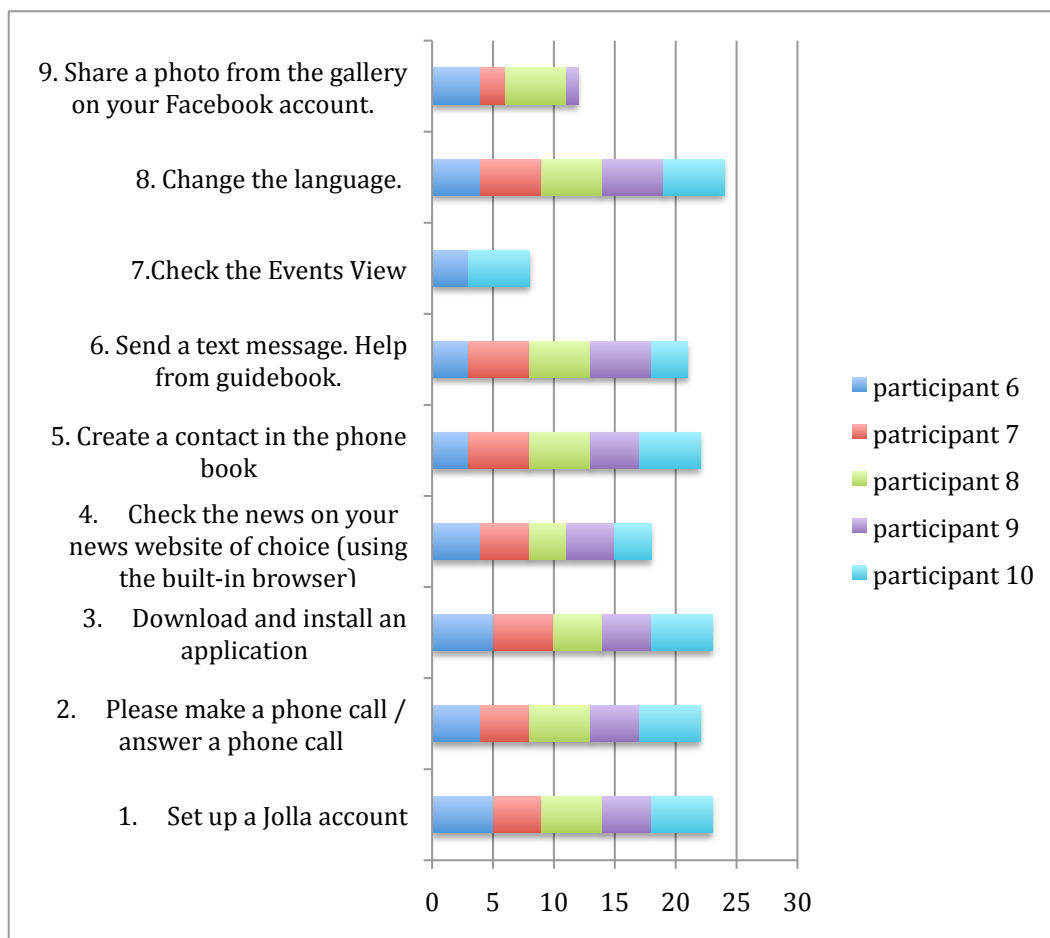


Figure 33. Non-Jolla users feedback on how easy was task performance for them. Evaluation from one to five, where five means very easy. X-axis shows the total score.

Setting up a Jolla account, downloading and installation of an application and changing language was evaluated as the easiest task to perform on Jolla by all participants. Four users commented that it was pretty straight forward and clear.

Checking events view and sharing photo on Facebook account were the most difficult tasks. According to the author's observations it was due to the following reasons:

- Confusion with checking events view was due to the big memory load during startup wizard, which offers users information about many new gestures. As information about events screen is at the end of animation, users do not remember it afterwards.
- Integration with social media was not clear for three non-Jolla users. Another problem was that Facebook application became unresponsive (three users) at the stage of login; error notification came late with a feeling that application is stuck.

All five non-Jolla users owned Android smartphone. The author supposes that it was the reason why users were missing "back" button and notification from system when task is completed (message was sent, contact created, photo shared etc.).

All five participants mentioned that they are interested/able/willing to spend time to learn new features on everyday basis if they see an advantage of this for the later use.

Two participants stated that they prefer learning by trying; three users told they would prefer tutorials on YouTube. Even though during task performance only one participant used tutorials on YouTube, this shows users willingness to learn by trying.

5.2.3 NON-JOLLA USERS EXPECTATIONS OF JOLLA AND ITS USABILITY.

All five participants describing their expectation of Jolla answered, that they think that Jolla is “Fresh&Different”.

Four participants after watching the tutorial “Tell me about the basics” answered, that UI looks easy to use. After task performance participants were asked to rank from one to five how easy was managing UI compared to their expectations. Ranking from one to five was based on following principle:

1= much more difficult than expected

2= more difficult than expected

3=as expected

4= easier than expected

5=much more easy than expected

Figure 34 below illustrates users’ expectations.

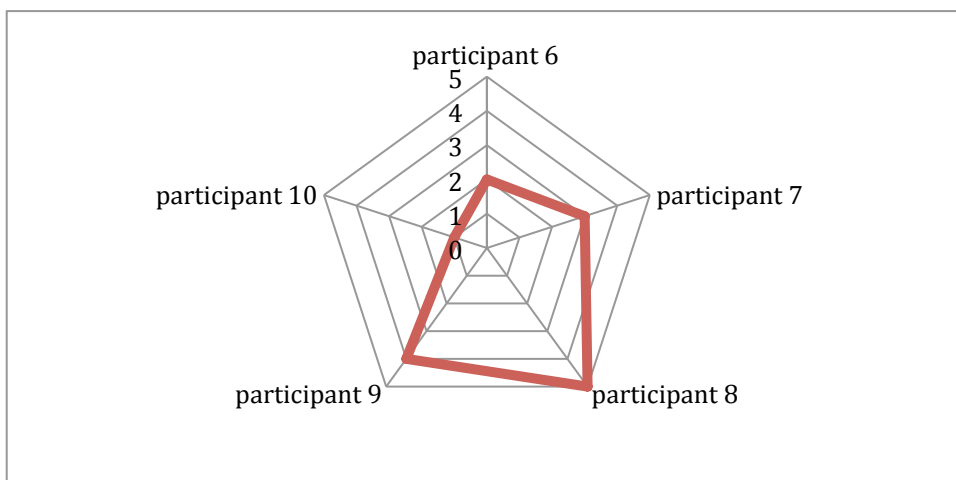


Figure 34. Evaluation of how easy UI is to use after task performance by non-Jolla users with ranking from one to five, where five is maximum score.

At the same time, describing user experience, no one from non-Jolla users commented that their experience was difficult or boring. All five non-Jolla users told it was interesting, confusing (three participants) and easy (three participants). Figure 35 below illustrates comments on user experience after task performance.

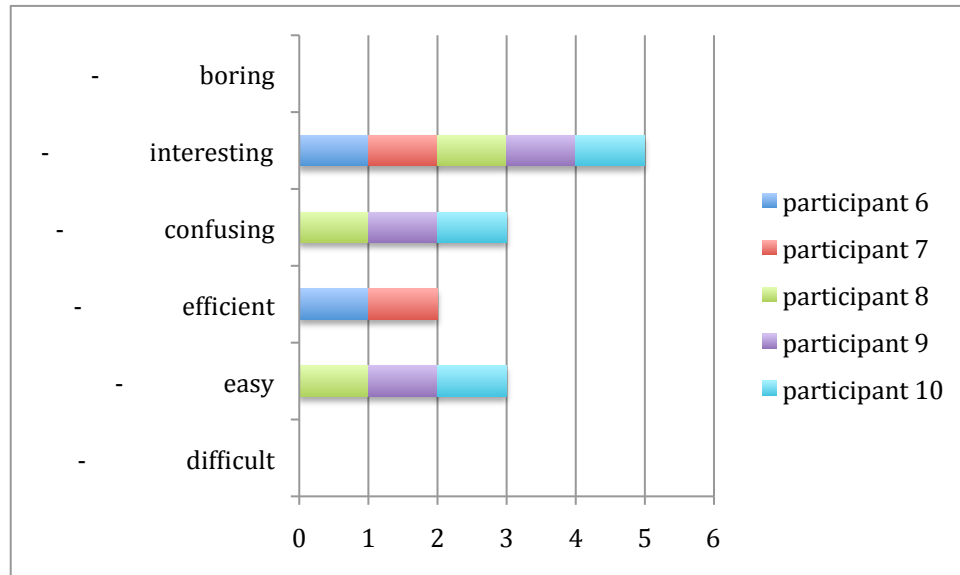


Figure 35. Comments on user experience after tasks performing.

Based on analysis of Figure 34 and Figure 35, the author assumes, difficulties during task performance were due to users confusion with new gestures.

5.2.4 EXPERIENCE OF USING APPLICATIONS.

Average number of applications Jolla-owners had installed on their smartphone was twenty-seven, average number of applications in daily use was seven. As it was mentioned earlier number of applications might be higher as sometimes basic applications are not taken into account.

As a “must have” applications were listed following: WhatsUp (three users), Facebook (three users), Mail (three users).

During task performance downloading and installing an application was one of the easiest tasks, four users evaluated it with the highest score. Two users have noticed, that they would prefer to have notification that application was installed.

5.2.5 JOLLA’S UNIQUE ADVANTAGES IN TERMS OF USABILITY.

As it was stated above swipe gestures, pulley menu and multitasking the author chose as “WOW” related features.

All nine tasks included use of gestures and pulley menu. Three non-Jolla users answered that swipe gestures were convenient to use and they enjoyed using swipe gestures to communicate with Jolla. One user told: “gestures are the best thing”. It was also mentioned that gestures are convenient to be performed by one hand as an advantage of Jolla. Pulley menu was not evaluated high by non-Jolla users, motion was confusing, one participant complained that during answering the phone call task phone vibration interfered with vibration of pulley menu.

Multitasking was used also in majority of tests. Running applications are indicated on home screen and as users went through the tasks, they were able to explore multitasking. Three users liked multitasking and gave following comments: “good, that its real multitasking, not suspended”, “nice that icon is displaying the content, not the actual application”. Three users liked an option of closing applications on home page by crosses or “close all” option in pulley menu.

Three participants from non-Jolla users group mentioned that these features would be important when they make the next smartphone purchase.

5.3 ANALYSIS SUMMARY, THE UNIQUE ADVANTAGES IDENTIFICATION AND PROPOSALS FOR THE CASE COMPANY.

Based on the research findings analysis, Jolla Ltd has an image of innovative company. Nine of ten participants mentioned that their expectations of Jolla were either “fresh&different” or “cool&different”. After task performance all five non-Jolla users assumed their experience was interesting. This shows that there is an interest among participants to try new and different UI.

Another important characteristic that describes overall product value is desire to own the product. Two Jolla owners stated that their next smartphone would be Jolla, another user mentioned: “something that runs Sailfish OS”. Two non-Jolla users commented that they want to own the product. This is a significant factor that shows overall satisfaction of Jolla.

5.3.1 PRODUCT INSIGHTS AND WOW RELATED FEATURES.

Based on the above mentioned the author supposes that swipe gestures and multitasking were evaluated as unique advantages by both user groups: Jolla owners and non-Jolla users. Table 4 below visualizes top ranked Sailfish OS features.

Highly evaluated by Jolla owners Sailfish OS features	Ranking from one to five, where five is the maximum score.
Gestures	

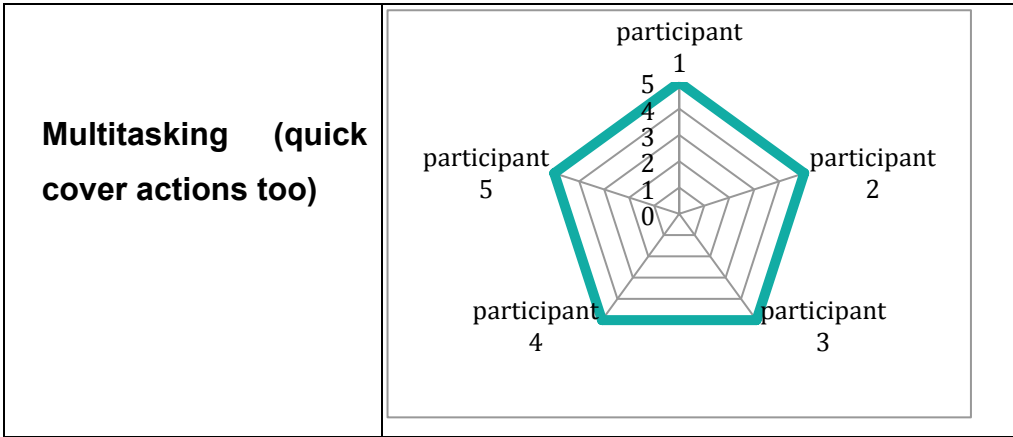


Table 4. The highest evaluated Sailfish UI features by Jolla owners based on ranking from one to five, where five is maximum score.

Gestures optimize user experience by less finger moves and taps, thus enhance efficiency in managing UI. Three non-Jolla users stated that they enjoyed using swipe gestures to communicate with Jolla even though it was confusing during certain tasks performance.

Multitasking feature raised significant interest from non-Jolla users, even though participants did not use many swipes to manage applications during tasks performance. The author assumes that advantages of multitasking can be fully evaluated during active use of Jolla on everyday basis.

5.3.2 USABILITY ANALYSIS SUMMARY AND THE PROPOSALS TO ENHANCE USABILITY OF SAILFISH OS.

Intuitiveness is a part of usability and critical software quality characteristic. Sailfish OS intuitiveness was highly ranked by Jolla owners, it indicates that users are able to operate UI naturally. Task performance results and absence of questions about OS features shows that Jolla owners are familiar with OS and do not encounter difficulties in managing UI.

Table 3 below illustrates evaluation of intuitiveness, usability and logic of Sailfish OS by Jolla owners and non-Jolla users.

As was stated above four Jolla owners evaluated Sailfish OS intuitiveness with the highest score, Figure 24 in Table 3. Additionally the Jolla smartphone owners mentioned that usability of Sailfish OS exceeded Jolla their expectations, Figure 26 in Table 3. Non-Jolla users evaluation presented in Figure 29, Table 3 and related to usability and logic of OS. Since non-Jolla users did not have much time to communicate with Jolla, their judgment of

usability was based mostly on the intuitiveness of Sailfish OS. Based on the above mentioned, the author assumes, that evaluation of intuitiveness by Jolla owners and evaluation of intuitiveness by non-Jolla users can be compared as it has similar meaning per se.

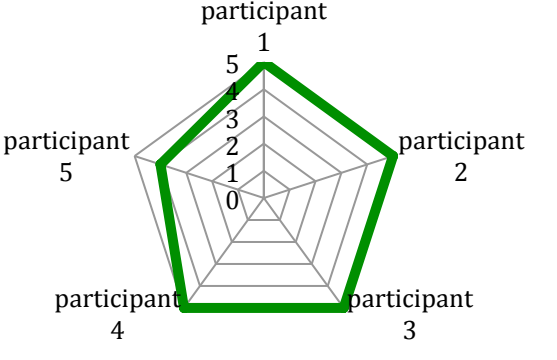
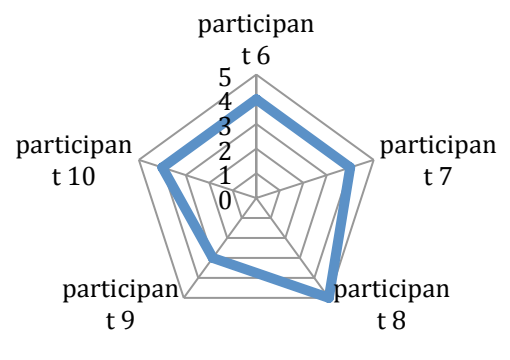
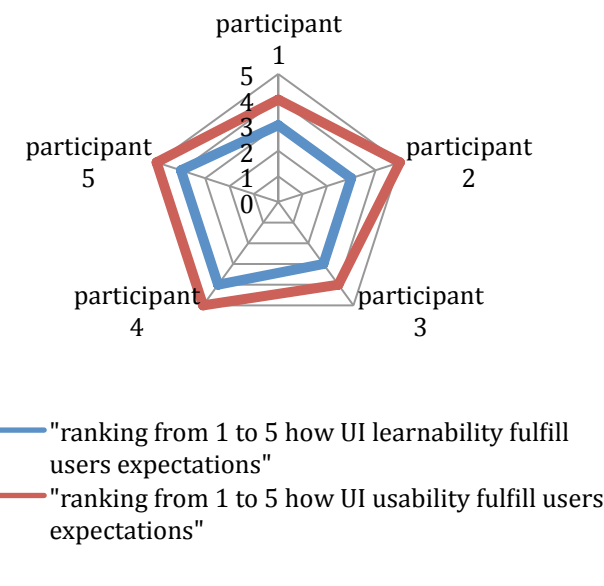
Jolla owners	Non-Jolla users
<p style="text-align: center;">Sailfish OS intuitivness</p> 	<p style="text-align: center;">Usability and logic of OS</p> 
<p><i>Figure 24. Jolla owner's evaluation of Sailfish OS intuitiveness by ranking from one to five, where five is very important.</i></p>	<p><i>Figure 29. Non-Jolla users' evaluation of Sailfish OS usability after task performance by ranking from one to five.</i></p>
 <p> — "ranking from 1 to 5 how UI learnability fulfill users expectations" — "ranking from 1 to 5 how UI usability fulfill users expectations" </p>	<p style="text-align: center;">-----</p>
<p><i>Figure 26. Evaluation how Sailfish OS met users expectations in terms of usability and learnability by ranking from one to five, where five is maximum score.</i></p>	

Table 3. Evaluation of intuitiveness, usability and logic of Sailfish OS by Jolla owners and non-Jolla users.

Three non-Jolla users, who ranked usability and logic of Sailfish OS by three and four, Figure 29 in Table 3, commented that steps needed to perform tasks were logical, but managing UI was confusing. Among with comment that experience of using Jolla was interesting, non-Jolla users stated that experience was easy (three users) and confusing (three users). None of them described it as a difficult.

The author emphasizes that all stated above shows that Sailfish OS is efficient ones users have learned how to operate it. Thus learnability of OS is becoming critical characteristic.

Figure 24, Table 3 illustrates that learnability of Sailfish OS did not exceed much Jolla owners' expectations. Moreover as it was stated earlier Jolla owners stated that the most challenging part of learning process was to learn about gestures. Gestures is significant part of experience in managing Jolla's UI. Thus the author assumes that Jolla Ltd. shall enhance learning solutions for users.

Based on the research findings, the most common and preferable way to learn about Jolla features are "learning by doing" and use of YouTube tutorials. The author's observations during usability study sessions with non-Jolla users detected that startup wizard and hints were effective learning tools. As stated in Section 5.2.2 the startup wizard requires big memory load, which leads to the situation that users do not remember minor gestures afterwards (in our case events screen swipe). Another change to the startup wizard, based on the author observations is recommendation to inform users about Jolla's social media integration. This is an important feature was not clear for non-Jolla users during task performance. Four users were searching for Facebook in Jolla's application store.

The author proposes to enlarge number of interactive learning solutions: hints, which appear only in the situation related to the specific task. At the same time two of five Jolla owners mentioned that hints are annoying for them. The author proposes two modes: new user (with enabled hints) and advanced user. New user mode shall have different hints to support users in learning UI paradigm.

Tutorials on You Tube were also marked as an effective way to learn about features, the author assumes that additional tutorials about Sailfish OS gestures, for example: top down swipe, one click dial number will enhance usability of OS.

5.3.3 IDENTIFIED AREAS FOR IMPROVEMENT.

Table 5 below represents the lowest evaluated Jolla features by Jolla owners.

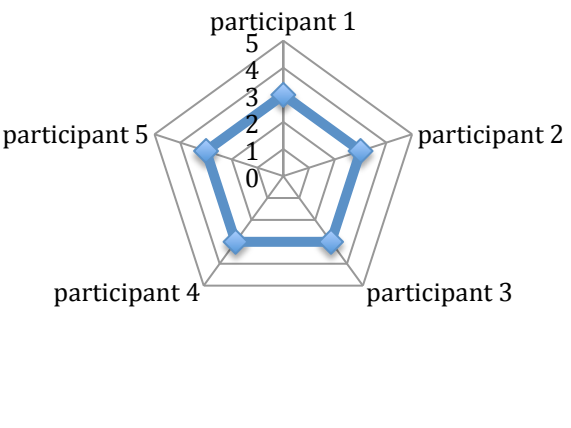
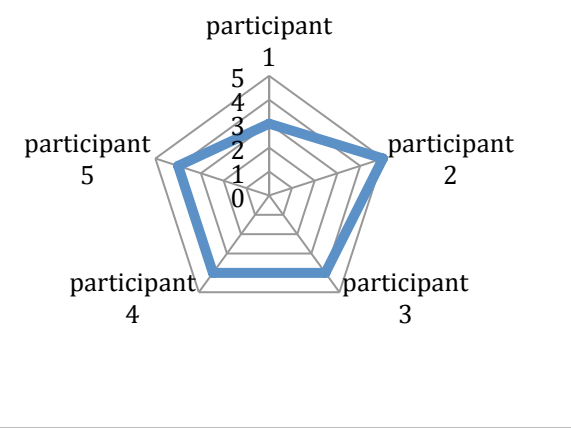
<p>The lowest evaluated by Jolla owners Sailfish OS features</p>	<p>Ranking from one to five, where five is the maximum score.</p>
<p>Available applications</p>	<div style="text-align: center;">  </div> <p><i>Figure 22. Evaluation of applications availability by Jolla owners.</i></p>
<p>Browser usability</p>	<div style="text-align: center;">  </div> <p><i>Figure 21. Browser usability.</i></p>

Table 5. The lowest evaluated Sailfish UI features by Jolla owners based on ranking from one to five, where five is maximum score.

Available applications were ranked lower compared to other features. Based on research findings, average number of applications installed on smartphone among Jolla owners and non-Jolla users were thirty-four, number of applications users need daily was eight. This shows importance and wide use of applications nowadays.

Non-Jolla users evaluated browser usability as the most important feature of OS. According to opinions of Jolla owners Jolla native browser has a room for improvement. Difficulties that non-Jolla users encounter on the way by using Jolla built-in browser are listed in Appendix 5.

5.3.4 NEW TARGET GROUP PROPOSAL.

Jolla owners are following software updates (two days after the release all five users had already the latest version of Sailfish OS) and actively supporting each other through communities. At the stage of finding participants for usability study, the author communicated with different Jolla owners and discovered that there is a great interest towards Jolla from people in their forties. Founder and Editor-in-Chief of jollasuomi.fi and foorumi.jollasuomi.fi Toni Aaltonen commented: "Actually I think that the Jolla is for everyone, for any age and any gender. I have seen women in their 20's and women in their 50's using Jolla, and same goes for men also. I think the main factor in this is that the product is Finnish and as Nokia is gone people want to try something unique."

The author proposes to identify new target group for users who are interested in new unique products and willing to learn new things.

As it was stated in Introduction, Jolla Ltd. is planning to enable Sailfish OS download on Android based smartphones. Taking into account that Android market share at the end of the year 2014 was about 80%, Android users is significant target segment for Jolla. To enhance Android users usability the author proposes introduction of "back" button gesture and task completed notification.

6.1 CONCLUSION.

Usability is a significant quality characteristic of an information technology product and one of the most important factors in the success of a software product. Designing a usable software product is challenging, designing usable OS for a mobile platform is double challenging. Mobile screens are limited in a size and force designers to find relevant solutions. Small screens with fewer visible options at any given time, too little space for keyboard and multiple windows limit solutions to support user behavior. Due to above mentioned factors usability of UI paradigm is playing increasingly important role in a mobile software product development. This Master's Thesis is a case study of a smartphone startup Jolla Ltd. and explores the usability of Jolla's Sailfish operating system.

The case company Jolla Ltd. is Finland-based smartphone manufacturer, which was founded in Pirkkala, Finland in March 2011 by ex-workers of MeeGo. Nowadays Jolla's offices are located in Ruoholahti, Helsinki (HQ), Tampere, Finland and Hong Kong, SAR of China. Jolla, the first unveiled device powered by Sailfish operating system was released in November 2013.

Jolla's slogan "we are unlike" reflects a new vision on smartphone operating system (OS). Jolla's Sailfish OS is build to optimize users' experience by less taps and finger moves. New gestures allow quick ways to perform actions, that makes the phone experience much more efficient.

Currently, Jolla smartphones are available for orders to all European Union countries, Switzerland and Norway. Jolla Ltd. is expanding globally and negotiating with partners in several countries, including Russia, India and Hong Kong. Global smartphone and OS market is mature and market entry is challenging for emerging company such as Jolla Ltd. Market entry is challenging for emerging company such as Jolla Ltd. In order to enable market entry with less costs, consistent understanding and analysis of user experience in managing user interface paradigm is critical for Jolla Ltd. Thus the research objectives were set accordingly:

- To explore usability of Jolla UI
- To identify unique advantages of Jolla in terms of usability from users point of view.

The framework of this research was based on an overview of the best-documented practices of a usability concept and its evaluation methods. The empirical part of the study included ten one-on-one sessions with Jolla owners and potential Jolla buyers. These sessions consisted of questionnaires, interviews and test tasks. Video recording of task performance verified users' behavior during interaction process while talk aloud protocol enabled understanding of users' logic.

The research design was set in two rounds: five one-on-one sessions with Jolla owners and five sessions with potential buyers. The first round enabled to identify Jolla's "WOW" related unique features from Jolla users point of view, second round included evaluation of those features by potential buyers.

The research findings were grouped and analyzed by the author and presented in Chapter 5. Structure of analysis is based on the research objectives breakdown and includes following main areas: intuitiveness and learnability of Sailfish OS, users expectations in term of usability, users' experience of using applications and Jolla's insights and features evaluation.

Sailfish OS logic was highly evaluated by both groups of participants, the research findings showed that there is an interest among participants to try new and different UI.

Analysis identified an interesting aspect of Sailfish usability: OS efficiency far exceeded users expectations while learnability was just as expected. At the same time, the highest evaluated Sailfish OS feature swipe gestures were also mentioned as the most confusing. Thus, the author assumes that Jolla Ltd. should enhance learning solutions for users.

The author emphasizes that all stated above shows that Sailfish OS is efficient ones users have learned how to operate it. Thus learnability of OS is becoming critical characteristic.

The study resulted in analysis summary presented in Section 5.1 and the following practical recommendations to enhance usability of Sailfish OS:

- in order to improve learnability:

(1) Startup wizard optimization. The research findings showed that at the moment startup wizard requires too big memory load, thus the author

proposes to shorten startup wizard. Jolla's social media integration was not clear for non-Jolla users during task performance; information about this feature is essential.

(2) Enabling different modes for advanced and new users. Based on research findings, the most common and preferable way to learn about Jolla features is "learning by doing". The author proposes to enlarge number of interactive learning solutions: hints, which appear only in the situation related to the specific task and implement it only for "new user" mode.

- in order to reinforces experience of Android users:

(3) Implementation of "back" button gesture and task completed notification.

Jolla Ltd. is planning to allow Sailfish OS download on Android-based smartphones. Taking into account that Android market share at the end of the year 2014 was about 80%, Android users is significant target segment for Jolla. To enhance Android users usability the author proposes introduction of "back" button gesture and task completed notification.

According to the opinions of Jolla users, swipe gestures and multitasking are the most valuable features of Jolla. Non-Jolla users during test tasks performance were able to communicate with Jolla by gestures and experience multitasking. Swipe gestures and multitasking were highly evaluated by both groups of participants with following comments: "gestures are the best thing" and "good that its real multitasking, not suspended". The author supposes that gestures and multitasking might be taken as unique advantages of Jolla UI.

Based on all stated above usability study for the case company explored areas of the main interest in terms of usability. Jolla UI features were evaluated and the unique advantages from users point of view identified.

The author states, that continues repeatable users testing is the essential factor for Jolla Ltd success in building usable UI. Product evaluation in terms of usability from user perspective is critical for a software development.

Along with that and based on the research findings the author proposes the following areas for the further research: (1) setting up UX objectives on the same level with business and marketing objectives and identifying KPI's. This

enables target market refining and (2) building UX strategy to deliver a compelling, engaging and successful user experience.

In addition, the Thesis offers a wide range of the detailed proposals based on the author's observations and participants' opinions.

6.2 VALIDITY AND RELIABILITY

Section 6.2 concentrates on the key importance issues of any type of research: validity and reliability. Patton (2001) states that validity and reliability of qualitative research are two main factors, researcher should be concerned about while designing a study, analysing results and judging the quality of the study.

This Master's Thesis explores usability of Sailfish OS and based on Donmoyer's (2001) framework of five overarching purposes of qualitative research, the purpose of current study is "truth" seeking. According to Donmoyer whether findings to be truthful are determined by data quality.

In this study empirical data collection methods have been applied such as questionnaire, talk-aloud protocol, open-ended interview questions and data collection during task performance. In order to make sure that data are accurate and truthful with factual reference after each session the author validated all records with participants. Additionally video recording of task performance verifies users' behavior during interaction process while talk aloud protocol enables understanding of users' logic.

Ranking from one to five was implemented to enable accurate and truthful data collection in case of user's opinion about product or features. This method also simplifies and validates data processing and classification.

Interview questions and questionnaire were in English, which is not a native language for any of participants. To minimize possible language-related misunderstanding, researcher made sure, that all questions and task instructions were clear for participants.

Kirk and Miller (1986) refer to following types of reliability in quantitative research: the degree to which a measurement, given repeatedly, remains the same; the stability of a measurement over time; and the similarity of

measurements within a given time period (pp. 41-42). In this study number of participants has direct effect on reliability. Number of participants was chosen based on principles, recommended by Jakob Nielsen, Ph.D., User Advocate and principal of the Nielsen Norman Group. According to Nelsen (1993), the best results in product's usability problems identification during testing session come from no more then five users.

Relation between usability problems found and number of participants is shown below:

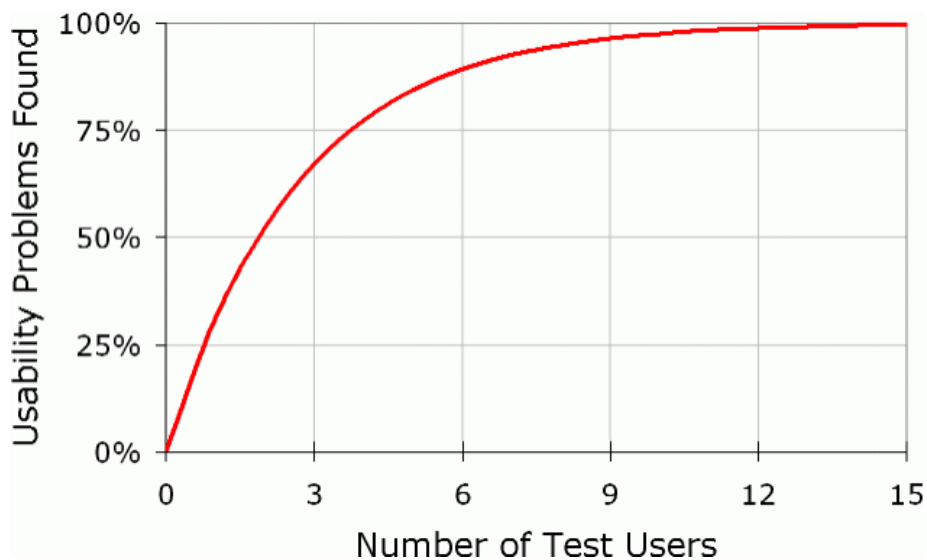


Figure 27. Usability problems found depending on number of participants, by J.Nielson and T.Landauer.

Curve above is build based on the following formula:

$$N (1-(1- L) n)$$

n=number users,

N=total number of usability problems in the design,

L=proportion of usability problems discovered while testing a single user.

Curve shows that after collecting data from five users, adding new users brings less and less information. In another words, after testing the fifth user, researcher observes almost the same data. Nielson advises to conduct as much tests as possible with no more then 5 users.

Usability study testing sessions for Jolla Ltd were conducted with two groups of participants: Jolla owners and non-Jolla users. Each group of users had different questionnaires and test tasks. Based on Nielsen's model, testing was conducted with 5 participants from each group.

According to Patton (1999, 1190), qualitative analysis is a creative process, thus outcome depends on insights of analyst. The author did not have work experience in the case company, in order to assure validity of this study, research objectives, research objectives breakdown and the detailed research plan was approved by Tim McDonald, Head of Marketing of Jolla Ltd.

The research objectives were set as following:

- To explore usability of Jolla UI
- To identify the unique advantages of Jolla in terms of usability from users point of view.

The research findings are grouped for analysis based on the research objectives breakdown: product insights, usability of Sailfish OS, users' expectations in terms of usability and experience of using applications.

The author supposes that objectives of the research were reached, as the outcome of the study is analysis of above-mentioned groups of findings and practical recommendations to enhance usability of Sailfish OS. Section 6.1 presented the author's proposals: (1) startup wizard optimization, (2) enabling different modes for advanced and new users, (3) "back" button gesture and task completed notification implementation. The unique advantages of Jolla are identified based on the case study participants' opinions: (1) swipe gestures and (2) multitasking.

REFERENCES.

Ballard B. 2007. Designing the Mobile User Experience.

Clarke A.C. Any sufficiently advanced technology is indistinguishable from magic.

Cooper A. 2004. Inmates Are Running the Asylum, The: Why High-Tech Products Drive Us Crazy and How to Restore the Sanity.

Creswell J.W., 2003. Article Research Design. Qualitative, Quantitative and Mixed Methods Approaches.

Davis N. 2011. The T-Model and Strategies for Hiring IA Practitioners. [www document] < <<http://uxmatters.com/mt/archives/2011/10/the-t-model-and-strategies-for-hiring-ia-practitioners-part1.php#sthash.oxdOaqSV.dpuf>>

Green W.S., Jordan P.W. 2002. Pleasure with products: beyond usability.

Gould J.D., Clayton L. 1985. Designing for Usability: Key Principles and What Designers Think.

Gould, Lewis 1985; Gould, Boies et al. 1991Els van de Kar, Designing Mobile Service Systems.

Engestrom Y. 2004. ACTIVITY THEORY AND EXPANSIVE DESIGN University of California, San Diego and University of Helsinki.

Haybe C. 1996. Integration of human factors for user interfaces into the software development life cycle" A Literature Review.

Kuniavsky M. Observing the User Experience: A Practitioner's Guide to User Research.

Laihiri A. 2013. Staying competitive through Strategic UX Design. Human Factors International. [www document] <http://info.humanfactors.com/acton/attachment/>

Marcus A. Design, User Experience, and Usability. Theory, Methods, Tools and Practice.

Marine L., Tyne S.V. 2011 User Experience: The Third Objective. Pragmatic Marketing. [www document]

<<http://www.pragmaticmarketing.com/resources/user-experience-the-third-objective>>

Nielsen J., Landauer, Thomas K. 1993. A mathematical model of the finding of usability problems. [www document]

<<http://www.nngroup.com/articles/why-you-only-need-to-test-with-5-users/>>

Nielsen J., Budiu R. 2013. Mobile Usability

Nielsen J., Norman D., Definition of user experience. [www document]

<<http://www.nngroup.com/articles/definition-user-experience/>>

Norman D. 2004 Emotional Design: Why we love (or hate) everyday things. New York, Basic books.

Patton, M. Q. 1980. Qualitative evaluation methods. Beverly Hills, CA: Sage.

Patton, M. Q. 1990. Qualitative evaluation and research methods (2nd ed.). Newbury Park, CA: Sage.

Patton, M. Q. 1999. Enhancing the Quality and Credibility of Qualitative Analysis. Health Services Research. 34:5 Part II (December). 1189-1208.

Rossman, J. E., El-Khawas, E. 1987. Thinking about assessment: Perspectives for presidents and chief academic officers. Washington, D.C.: American Council on Education and American Association for Higher Education.

Shneiderman B., Plaisant C. 2010. Designing the User Interface

Seffah. A, Donyaee M., Klein K.B., Padda H.K.. 2006. Usability measurement and metrics: A consolidated model. Springer Science [www document] <<http://www-psychology.concordia.ca/fac/kline/library/sdkh06.pdf>>

Wharton C. et. al. "The cognitive walkthrough method: a practitioner's guide" in J. Nielsen & R. Mack ["Usability Inspection Methods"](#) pp. 105-140. Wiberg C. 2003. A Measure of Fun Extending the scope of web usability, 2003. PhD Department of Informatics, Umeå University

Yin, R. K. 1984. Case study research: Design and methods. Newbury Park, CA: Sage