



DEGREE PROGRAMME IN ELECTRICAL ENGINEERING or
DEGREE PROGRAMME IN WIRELESS COMMUNICATIONS ENGINEERING

How usability is seen by software development organizations and their end-users?

University of Oulu
Department of Information Processing
Science
Master's Thesis
Toni Keränen
26.06.2022

Abstract

Software usability is usually the main thing a user thinks of along with functionality. For user it is important that they can use a software with ease to do their tasks. They pay attention to how it feels to use a software. For software developers, usability can be more complex topic that needs attention. Developer organizations need to focus on usability in order to make a product usable and manage to achieve that goal. This paper discusses about usability, its benefits and measure opinions between developing organizations and end-users. Thesis is based around usability literature and two questionnaires, one for developing organizations and other for end-users. There were 22 developers and 14 end-users answering to the questionnaires.

Keywords

Usability, Usability activities, Cost-benefit analysis, Software learnability

Supervisor

PhD degree in Information Processing Science, Mikko Rajanen

Foreword

I want to thank supervisor for instructing with my master's thesis and everyone who helped me by sharing thoughts and ideas during the work. Also, I want to thank individuals and companies who participated in my questionnaires.

Toni Keränen,

Oulu, May 27, 2022

Contents

Abstract	2
Foreword	3
Contents	4
1. Introduction	5
2. Background	7
2.1 HCI and Measuring usability	7
2.2 User experience (UX)	7
2.3 Usability activities	8
2.4 Cost-benefit analysis	9
2.5 Cost-benefit analysis models for developing organizations	10
2.6 Usability in open-source software development	10
2.7 Benefits found by previous literature	11
3. Research Methods	13
3.1 Research questions	13
3.2 Methods	13
3.2.1 Questionnaire: General questions	15
3.2.2 Questionnaire: Usability related questions	15
3.2.3 Questionnaire: Usability-benefit related questions	15
3.3 Data analysis	16
4. Results	17
4.1 Questionnaire results: Developing organizations	17
4.2 Questionnaire results: End-users	23
4.3 Findings	28
5. Discussion	31
5.1 Limitations	31
5.2 Future research	31
6. Conclusions	32
References	33
7. Appendices	36

1. Introduction

Information and communication technology (ICT) have become technology we use every day by using smartphones, computers and different software at work. As usage of ICT is becoming daily activity and software are getting more complex, usability becomes an important factor that both users and developing organizations can benefit.

There are at least three definitions of usability by ISO standards. One and common definition of usability is “The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use, where effectiveness is fundamental as it is about achieving the intended goal(s)” (ISO 13407). Another definition of usability is being one of the main product quality attributes according to international standard ISO 9126. Meaning capability of a product to be understood, learned, used and attractive to the user, when used under specified conditions (ISO/IEC 9126). Third definition of usability is “The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use, where effectiveness is fundamental as it is about achieving the intended goal(s)” (ISO 9241-11).

At some point, usability was extended to incorporate user experience (UX) that means subjective feelings and assessment of the individual user is added to the concept of usability (Rajanen & Rajanen 2017). Bevan et al. (2015) describes UX as follows: Focus of the UX is on users’ preferences, perceptions, emotions and both physical and psychological responses during use of a product, before using a product and after using a product, instead of observed effects and efficiency. They also point out that user experience is typically associated with satisfaction dimension of the usability. While usability typically focuses on user group goals, UX focus on individual goals as well as considers how experience using a product change with repeated use (Bevan et al., 2015). User-centered design process can have positive effects for developing organizations such as providing competitive advantage and reduce developing costs (Rajanen & Rajanen, 2017).

User interface (UI) is the visualization of a software that user sees. Purpose of the UI is to give access to a software’s functionality and allows users to do their tasks. Usability, user experience (UX) and UI are connected to each other’s. Usability incorporates things as how functionality of the software is designed, how effectively and efficiently user can complete their intended goals, and how satisfying it is. UX in other hand, focus on personal preferences of individual users. User’s preferences and expectations before, during and after the use. (Rajanen, 2021)

Development organizations can have many potential benefits from usability such as increased productivity and customer satisfaction (Rajanen, 2006a), but bringing usability activities into software development life cycle is not easy (Ohnemus, 1996). Business management is important factor for implementing usability activities in development projects. Usability has been competing for resources with other project groups that have objective cost-benefit data available, while cost-benefit for usability is not so clear to identify and calculate. (Karat, 1994)

Development management see usability activities often as a potential risk for their project deadline while customers and end users think usability is important product attribute (Rajanen, 2006b). Kohno et al. (2013) opinion is that development management who does not know much about usability activities, it is necessary to clarify activities, investments,

benefits and relationships between activities and benefits (easier understanding due to input-output relationship).

Usability activities in a product development is beneficial for both developing organization and its customers (Ehrlich & Rohn, 1994). Usability can be an important competitive edge in software markets (Rosson & Carroll, 2002). On the other hand, for example, poor usability can have negative effects like bad reputation of a company (Rajanen, 2020).

Developing organizations and end users have differentiate thoughts and feelings about usability. This topic focus on how usability is seen from developing organization's point of view and from end user's point of view, as well as how do those two differ from each other's.

Research questions of the study are following:

1. What benefits do software development organizations and software users expect from software usability?
2. How are software usability benefits seen from software development organizations' and software users' view?

In this thesis, second chapter (2. Background) discuss about usability and usability related things basing in usability literature. The chapter covers topics that are used to make the questionnaire. Next chapter (3. Methods) discuss about the methods how questionnaire is structured and why. The chapter explains the questionnaire and discuss about the key questions. Results chapter (4. Results) shows the results for the questions and discuss about divide of the answers and initial findings. Section 4.3 *Findings* look up how answers from the two questionnaires (for developing organizations and users) correlates. Discussion (5. Discussion) discuss about usability and the results, as well as limitations and future research. Finally, chapter 6. *Conclusions* explains this thesis and results shortly.

2. Background

This literature review focuses heavily on usability. Usability is the main factor for this research. The literature review will look into different usability related topics such as what is usability in software development, how usability is taken account in software industry and what can be the benefits of usability by previous literature.

This chapter includes knowledge about human-computer interaction, measuring usability and more about UX, UI and usability. Later in the chapter, usability activities in developing organizations, benefits usability can bring, cost-benefit analysis and usability in open-source development are reviewed.

2.1 HCI and Measuring usability

Human-computer interaction (HCI) has many efforts to be explained. One straightforward definition of the HCI is “the capability to be used by humans easily and effectively” (Shackel, 1991). Other defines, for example, are “quality in use” (Bevan, 1995) and “the effectiveness, efficiency and satisfaction with which specified users can achieve goals in particular environments” (ISO, 1998). A key research question in HCI is, how to work with interactive systems and how to improve usability of the interactive systems. (Hornbæk, 2006)

Measuring usability is not straight forward and the topic has a lot of studies done in the HCI field. The studies point out problems with measuring usability. Such problems are if the measures actually measure usability and cover usability broadly. Also, the question is, are the measurements of usability explained and backed up by other studies or meeting the recommendations of how to measure usability. (Hornbæk, 2006)

There are many discovered usability measures found by researchers but choosing the right ones is difficult. These kind of measurements of usability are for example, measuring effectiveness, efficiency and satisfaction while using a software. All the three categories have large number of different measures like effectiveness has variables as accuracy of completing tasks, precision or how well user recall information from the UI, as an example. Efficiency has variables such as time completing tasks, input rate with the UI or use frequency of the functionality. Satisfaction category for example, has measures as attitude towards content of the UI, user’s satisfaction with specific features or how easy user feels using a software. Current practice in measuring usability is thinking that choices of usability measures, and how usability measurements are used, weakens the results and conclusions. (Hornbæk, 2006)

2.2 User experience (UX)

Often humans value technology as a tool to gain time to do something else or to do something more efficiently which gives a user satisfaction. Some recent discussions raise the point that using technology itself can be satisfactory as well. Accomplishing merely externally given tasks with technology might be too limited view of what technology brings with it. Feelings and experiences can be also motive for using technology. Experience can be a momentary feeling of pleasure or pain in various intensities. Pleasure and pain again, comes from fulfilment of basic human needs. (Hassenzahl, 2008)

UX is often misunderstood as a synonym of usability and user-centered design. The most noticeable difference between usability and UX is that usability focuses on performance as outcome of human-product interaction while UX focus on well-being. (Hassenzahl, 2008). Bevan et al. (2015) describes UX as follows: Focus of the UX is on users' preferences, perceptions, emotions and both physical and psychological responses during use of a product, before using a product and after using a product, instead of observed effects and efficiency. Hassenzahl (2008) describes his own definition of UX as follows: UX is a momentary, primarily evaluative feeling (good-bad) while interacting with a product or service.

UI, UX and usability are different things even they are connected to each other's. UI is the system for the user and what user sees without knowing what happens in the background. Usability incorporates things as how functionality of the software is designed, how effectively and efficiently user can complete their intended goals, and how satisfying it is. UX in other hand, focus on personal preferences of individual users. User's preferences and expectations before, during and after the use. (Rajanen, 2021)

Hassenzahl (2008) also defines UX as follows: "Good UX is the consequence of fulfilling the human needs for autonomy, competency, stimulation (self-oriented), relatedness, and popularity (others-oriented) through interacting with the product or service (i.e., hedonic quality). Pragmatic quality facilitates the potential fulfilment of be-goals".

Challenge of UX is that it is difficult to know what person is thinking and feeling in his head. In other words, how to get into people's head while they are interacting with a product or service. When does user move on some direction on good-bad experience scale and how to know when persons are having single outstanding moments of feelings? (Hassenzahl, 2008)

2.3 Usability activities

Usability activities can benefit a developing organization variety of ways, such as increased productivity and customer satisfaction (Rajanen, 2006b), but bringing usability activities into software development life cycle is a challenge (Ohnemus, 1996). Then again, poor usability can affect negatively to developing organization's reputation and image (Rajanen & Iivari, 2007).

Business management is important factor for implementing usability activities in development projects. The management level support is only achieved when usability can be identified and calculated. That can be done with cost-benefit analysis, where expected costs and identified benefits are identified and quantified. (Karat, 1994)

Incorporating usability activities to development can have considerable risks of potential failure in commercial development context because costs and efforts are concrete and obvious, while benefits from usability activities are harder to see and confirm. If management is not convinced that usability activities are beneficial, usability activities can be even abandoned by the developing organization. (Rajanen, 2011)

Some development organizations do not see benefits of usability activities. Rajanen and Iivari (2007) found in their empirical company case that the company expected to get better sales and reputation in the eyes of a customer. However, they saw usability activities as a cost without any visible benefits. Therefore, usability activities were seen not beneficial enough for the company (Rajanen & Iivari, 2007). There are also

development organizations that see potential benefits of usability activities. Company open-source software (OSS) case by Rajanen and Iivari (2010) had a case where usability and user interface (UI) were emphasized a lot. For example, usability specialist pointed out that if product costs as much as competitors and is much harder to use, why would anybody choose them (Rajanen & Iivari, 2010). Also, Rajanen and Nissinen (2015) found out that smaller game companies lacked knowledge of usability activities and benefits of usability, compared to larger game development companies. Game development itself has gotten much harder in the past ten to twenty years, (Blow, 2004). Blow (2004) discuss about games getting complex and requires deep technical knowledge and difficulty raises at the same time as implementation abilities increase. Difference to regular developing and OSS development is that in game development, third-party modules need to be used and different tools has to be used (for example, for animations, game engines that requires deep technical knowledge), which adds complexity and technical knowledge requirements (Blow, 2004).

2.4 Cost-benefit analysis

Revision of the ISO 9241-11 standard proposed to include organizational perspective to the usability. The Revision acknowledges that usability can overcome potential risks and negative effects of inappropriate interaction with product, system, or service. This revision caused usability benefits and costs for organizations to become officially recognized. (Bevan, Carter & Harker, 2015)

Cost-benefit analysis is a method to analyse projects when making investment decisions (Karat, 1994). The method is to compare the advantages and disadvantages of an action and make decision based on it (Rajanen, 2006a). Data about function or business situation are gathered and that data assist in decision making about resource allocation (Rajanen, 2006a). The aim is to use the resources best possible way to have low costs and high potential benefits (Rajanen & Rajanen, 2017). Burrill and Ellsworth (1980) explain this method to identify the financial value of a project and benefit variables first, analyse the relationship between the expected costs and benefits, and finally, make the investment decision. Cost-benefit analysis is done in the planning phase of a project (Maguire, 2001).

Different authors approach cost-benefit analysis differently. Also, thinking where analysis should focus on, vary. Focus can be on the benefits that are interesting for the audience of the analysis (Mayhew et al 1994), focus can be split for both development organization costs and customer organization benefits (Donahue, 2001), focus can be on better usability during development, sales, use and support phases (Bevan 2000), focus can be on benefits from the viewpoint of vendor company, corporate customer and end user (Ehrlich et al 1994) and the focus can be on benefits by cost-benefit calculation of human factors work (Karat, 1994).

Usability cost-benefit costs can be divided to one-time costs, recurring costs and redesign costs. One-time costs are costs that are used initially for better usability, for example, establishing test laboratory, OSS repositories or usability forums. Recurring costs are costs that happens regularly such as salaries or incorporating usability specialists in development projects. Redesigning costs are additional costs that happens in each prototype iteration. Also, there is hidden costs like developer's time used for learning and helping out their colleagues (Karat, 1994). Ehrlich and Rohn (1994) divide actual usability costs to initial costs and sustaining costs. (Rajanen & Iivari, 2010)

Karat (1994) Mention that it can be hard to identify and calculate costs and benefits. However, according to Mayhew and Mantei (1994) calculating cost of better usability can be straightforward when necessary usability tasks are identified.

One good example how cost-benefit analyzing is not always so simple is following: When providing support is part of a company's business model, better usability actually reduces company's earnings. However, poor usability may harm the company's and its product's image and popularity, reducing earnings also in that case. (Rajanen & Iivari, 2007)

2.5 Cost-benefit analysis models for developing organizations

Usability can be an important competitive edge in software markets (Rosson & Carroll, 2002) but bringing usability activities into software development life cycle is a challenge (Ohnemus, 1996). Identifying and calculating benefits of usability is not easy (Karat, 1994). For that problem, models of cost analysis models have been introduced to help estimate and reveal the costs and benefits of better usability (Rajanen & Iivari, 2010). These models are meant to be used to convince management and developers to use usability activities in their developing process (Rajanen & Iivari, 2010).

In literature, there are two ways to approach usability cost-benefit analysis models. Some authors have user-centered design approach, and the others have usability task approach. User-centered design approach identify cost and benefits of user-centered design activities. Usability task approach identify costs and benefits of individual usability tasks. User-centered design activities can contain individual usability tasks so user-centered approach can be more comprehensive approach for cost-benefit analysis. (Rajanen, 2006a)

Rajanen (2006b) notice that some usability cost benefit models are from the point of view of a starting development project or identified by a member of a usability team. He sees that point of view is not optimal because some of the potential benefits are directed to a whole organization. Instead, Rajanen (2006a) mention that to take all the possible benefits fully into account, point of view for usability cost-benefit analysis should be from organizational point of view. Also, one point to notice is that existing cost-benefit models does not take into account developing organization's business model or a product (Rajanen, 2006a).

2.6 Usability in open-source software development

In OSS development, usability is traditionally secondary point of interest. Technology and functionality are heavily focused. Because of that, usability of OSS solutions might be complicated to use for non-developer users and therefore hinder the use of the OSS solution. (Rajanen & Iivari, 2010)

Open-source software development (OSS) is as software which source code is available for everyone to read and modify and the fundamental idea is that software can evolve by community (Rajanen & Iivari, 2010). Also, end-users can fix defects and modify the software for their personal needs (Raymond, 1999). OSS development can be done by community or company, which can have usability specialists contributing to the project (Rajanen & Iivari, 2010). Small community-based OSS projects usually have no corporate resources for usability (Rajanen & Iivari, 2010) unlike large projects where community are involved there might be usability resources available (Benson et al 2004).

Community and company OSS development can reduce development costs by less need for resources and getting to the market earlier (Rajanen, 2006a). Company OSS development case by Rajanen and Iivari (2010) shows that usability activities can have benefits in company OSS development with usability specialist contributing. In that case, the time was saved by having software to experiment and test in real use earlier phase in the development than usually in company OSS development. (Rajanen & Iivari, 2010).

The time can be saved in both community and company OSS development due to less need for redesigning as usability have been worked with throughout the project. The saved time allows to use more time for testing, designing and possibility to do more late changes (Rajanen & Iivari, 2010).

OSS communities are great source for having feedback fast and easy. For example, OSS communities can have discussion forum for usability. OSS traditionally do not initially focus on usability so forums can help with that problem. Also, users without coding skills can help with functionality and ideas for UI on the forums. Active communication can prevent having bad design solutions for usability in the early phases of the project when it is easier to make changes. (Rajanen & Iivari, 2010)

2.7 Benefits found by previous literature

Benefits of usability can be hard to identify and calculate (Karat, 1994) but also in some cases potential benefits can be estimated easily (Rajanen, 2006b). When necessary usability tasks are identified, calculating better usability can be quite straightforward (Mayhew & Mantei, 1994). Reason why it is difficult to estimate some of the potential benefits is because some areas of usability are quite abstract like company reputation, for example, (Rajanen, 2006a; Rajanen, 2011; Rajanen, 2020). From another point of view, potential benefits for organizations are easier to calculate than calculating potential benefits to the end users (Rajanen 2006b).

Better usability and increased sales sometimes have a link, but usually it is difficult to say if increased sales happened directly from better usability (Ehrlich & Rohn, 1994). Ehrlich and Rohn (1994) states that one way to identify relation between usability and sales is to analyze the importance of the usability in the buying decision. In company OSS development, potential benefits and competitive edge can be gained for sales by positive user satisfaction and good user-interface (Rajanen, 2010).

Better usability can reduce support costs. Poor usability can lead to situation where need of a support for a product is high and that directly means higher costs. Better usability can have great savings due to less need for product support. (Ehrlich and Rohn, 1994)

Development organization can cut development time and costs (Ehrilch & Rohn, 1994; Donahue, 2001) by incorporating usability techniques and achieving better usability (Ehrilch & Rohn, 1994).

Better usability can increase user productivity (Karat, 1994; Ehrilch & Rohn, 1994; Bevan, 2000) by reduced task time. Benefits can be gained also when there is less need for training for the end-users, therefore reducing the training costs (Ehrilch & Rohn, 1994; Bevan, 2000; Mayhew & Mantei, 1994). Ehrilch and Rohn (1994) adds another point of view to the training costs, hidden training costs for peer-support, as end-users often seek help from colleagues. Peer-supporting colleagues then reduces their own productivity (Ehrilch & Rohn, 1994).

Karat (1994) mention reduced staff turnover as a benefit. Ehrilch and Rohn (1994) points out that end-users can benefit from the better usability by having greater work satisfaction.

Potential benefits can be categorized to be in development context or use context. In development context, potential benefits of better usability are increased sales, reduced development costs, reduced training costs and reduced support costs. In use context, potential benefits of better usability are reduced training time, increased productivity and increased customer satisfaction and increased user satisfaction. (Rajanen, 2011)

3. Research Methods

This chapter defines methods used in the master thesis. Research questions are discussed and how the study is conducted. First, the idea and reason for the study are explained, then how data is gathered, and finally, how the data is analysed.

3.1 Research questions

Appendix 1. The study examines how software development organizations and their software end-users relate to usability. Do software development organizations incorporate usability activities in their development? Do they find usability as an important part of the development? Do they feel that good usability is beneficial for the organization? For software users, purpose is to find out what users expect the usability to be and how important good usability is for the end users of a software. All the questions and sources from literature are listed in a table in appendices (Appendix 1, Questions: Developing Organizations, Appendix 2, Questions: End-Users). Many questions are based to central topics about usability and are discussed more or less in different papers, so many sources are classified as “*no specific source*”.

The purpose of the study is to compare software development organizations and end-users’ opinions about usability. How does both point of views see and feel the usability and how important they see it? A crucial factor of the study is benefits and how do the answers from the two point of views correlate. Benefits are important because both software developing organizations and end-users can benefit from good usability.

Research questions of the study are following:

1. What benefits do software development organizations and software users expect from software usability?
2. How are software usability benefits seen from software development organizations’ and software users’ view?

3.2 Methods

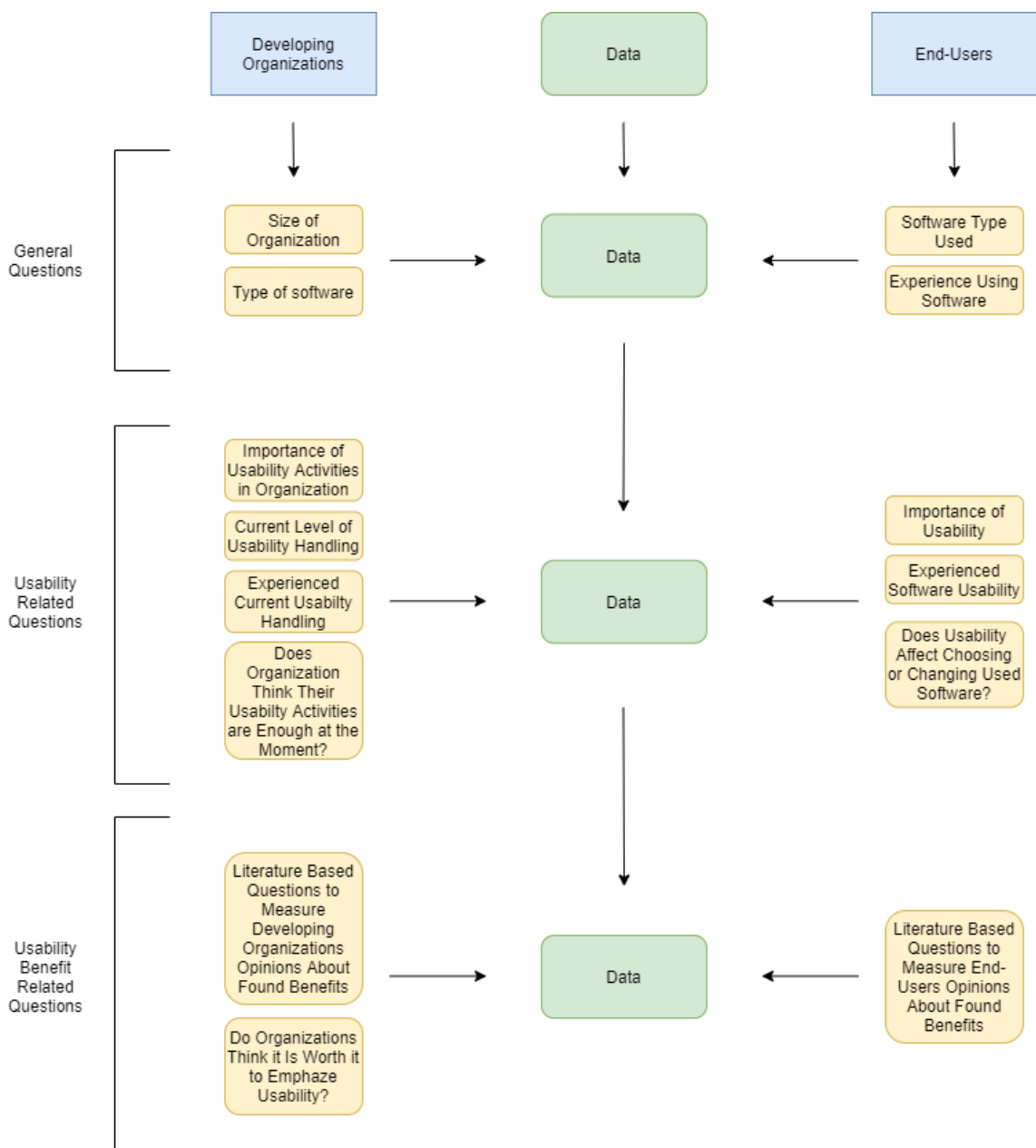
The study is conducted by two questionnaires. As a research method options were quantitative or qualitative method (Williams, 2007). The method used is quantitative research method. Quantitative method is selected because qualitative method could be hard to analyse and find relevant results for the topic. Quantitative method allows larger sample due to more answers and easier analysing. Qualitative method could be possible, but it would need many participants to be relevant, meaning heavy workload to analyse and find relevant findings. However, the questionnaire is not fully quantitative. There is an open answer included to have subjective points for usability to make possible findings by qualitative method as well.

The two questionnaires are for developing organisations and for end-users. The questionnaire for developing organisation is more detailed as this study focus more on developing organizations and how they deal with usability in their organizations. End-user’s opinions about usability and how they have experienced usability are used to see how they correlate with developing organisation’s point of view.

Questionnaire questions are categorized to 3 phases to structure the questionnaire and to get comparable results between the two stakeholders, as shown in Figure 1. The phases are:

1. General questions to categorize data between different sized developing organizations, different type of software and different skilled end-users.
2. Usability related questions to gain data about developing organizations thinking about usability, current level of usability activities as well as end-users thinking about usability and experiences.
3. Usability benefit related questions to gather data based on literature from both stakeholders.

Figure 1: Structure of the questionnaire.



3.2.1 Questionnaire: General questions

General questions for both developing organizations and end-users gathers usual information from the respondents. For developing organizations also size of the company and developed software type are identified. For end-users, additional information about user's software usage habits and experience using software are identified.

3.2.2 Questionnaire: Usability related questions

For developing organizations major questions are to find out how organization itself feels about usability of their products, how software usability is tested and how much they focus on usability. Organization's thinking about usability is key factor in this study. Thus, data about their insights about usability of their products and importance of usability in their opinion, are gathered. Testing usability is also an important question. There are many ways to test software during and after release. The question is, does developing organizations test usability of their products and if they do, how. In addition, some other more specific questions about organization's methods with usability are asked to get better overall picture.

For end-users' major questions are how they have experienced usability and how important usability is for them, when using software. These questions are meant to find out how end-users think about usability of software they use and if developers in their opinion focus enough for it.

3.2.3 Questionnaire: Usability-benefit related questions

Usability-benefit related questions are more specific and based on literature of usability. Questions are also targeted at individual persons about usability and opinions, instead of bigger picture of usability in end-users' case or about usability in their companies in developer's case. Questions basing in literature means that questions are specific questions that are pointed out in usability research field. The content of the questions focuses on benefits of the usability. At the end of the survey, open field is given to possibly get some other insights that this study has not covered.

For developing organizations questions are literature based and more specific to individual developers. Aim is to find out their opinions about usability related details and what do they think about different question marks in usability literature, that are covered in background section. The key questions are related to usability and correlation to number of users, monetary questions, and usability during development cycle.

For end-users, the more specific questions are to be answered based on one software they use in their work regularly. Software used is first identified and then other questions follow. The aim of this section is to find out end-users' opinions about usability and how they feel developers are paying attention for usability of their products. The questions are not only focused on benefits of usability, but also for their perceived experience with a familiar software.

3.3 Data analysis

While choosing a platform for the questionnaire the major factors were that platforms should have basic functions for questionnaire with open field possibility and for most importantly, to be able to export data to form that it can be analysed with other software. Google forms offered all these functions, so it was chosen as a platform. For analysing and making diagrams, Rstudio was used.

To questionnaire for developing organizations, it was fairly easy to find respondents. However, finding respondents for end-user questionnaire was a challenge. A lot of searching and time was used to find enough respondents for the end-user questionnaire. Companies searched for both questionnaires were mainly located in Oulu, but also other cities all over the Finland such as Helsinki, Tampere or Turku.

In this study, there are 22 respondents for the developing organization questionnaire and 14 respondents for end-user questionnaire. Because of the challenge to find respondents for the end-user questionnaire, number of respondents were limited to be around similar for both questionnaires.

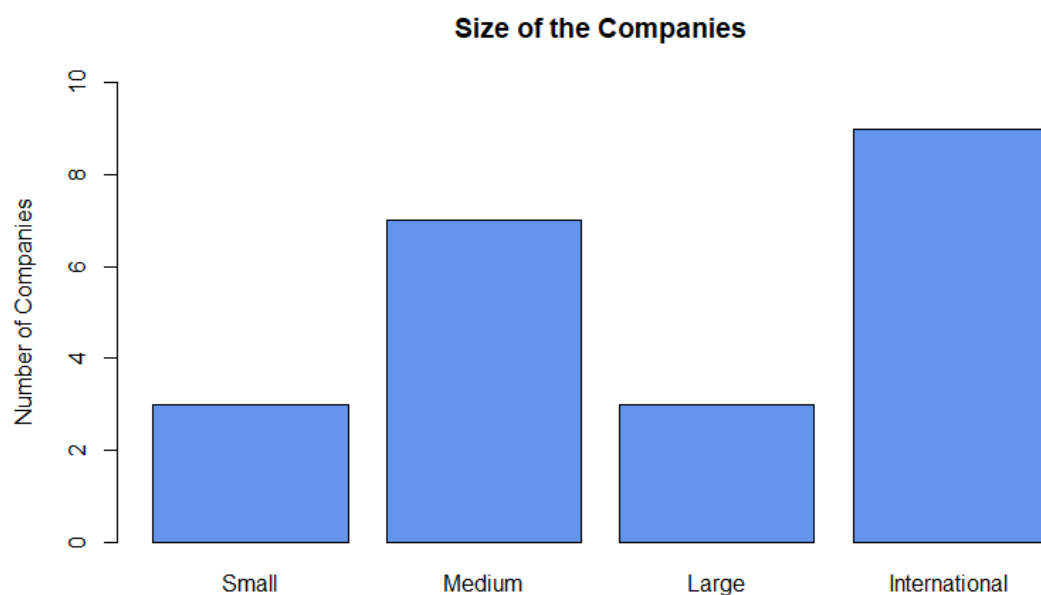
4. Results

Results chapter analyses the data gathered by the questionnaire. Data is extracted from the two questionnaires and taken for a closer look. First, results are explained and shown. How are respondents answered to the questions and which things seems to be dominant among the answers. Second part of the chapter discusses about findings of the results. Opinion scales used are 1-7 where 1 is low and 7 highest.

4.1 Questionnaire results: Developing organizations

There were 22 answers for the questionnaire for the developing organizations. From the answers 3 came from small company (offices in one city), 7 from medium sized companies (offices around the country), 3 from large companies (many or large offices around the country) and 9 answers from international sized companies (Figure 2). Developed software of these companies vary. Most common software developed is web application (90,5% from the answers), applications (76,2%), regular software (71,4%) and cloud (66,7%). Also embedded systems and system software were usual with both 57,1% from the answers.

Figure 2: Size of the companies.



One of the important questions is how developers themselves feel about usability in their company, products and benefits. Rajanen (2011) and Rajanen (2006b) had cases where development organizations saw risks with project deadlines or did not see benefits of usability. Results were quite clear that developers feel that usability of their company products is important (Figure 3). There were no answers from 1-3 at all, while total agreement of product usability being important to the company was 10 answers in total.

Figure 3: How important developers feel that product usability is to their company. Scale 1-7 where 1 is low and 7 highest.

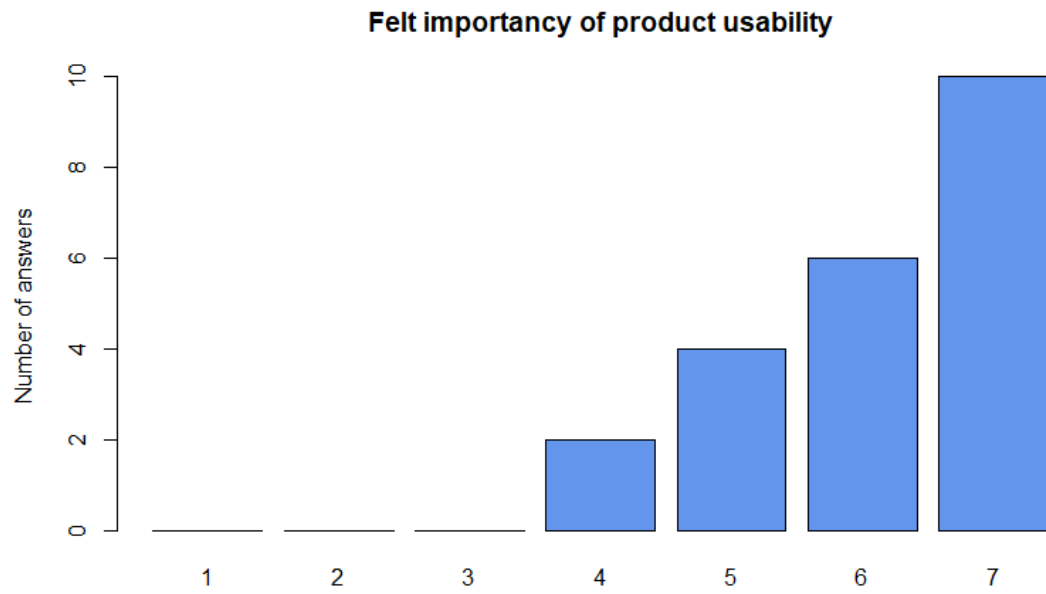
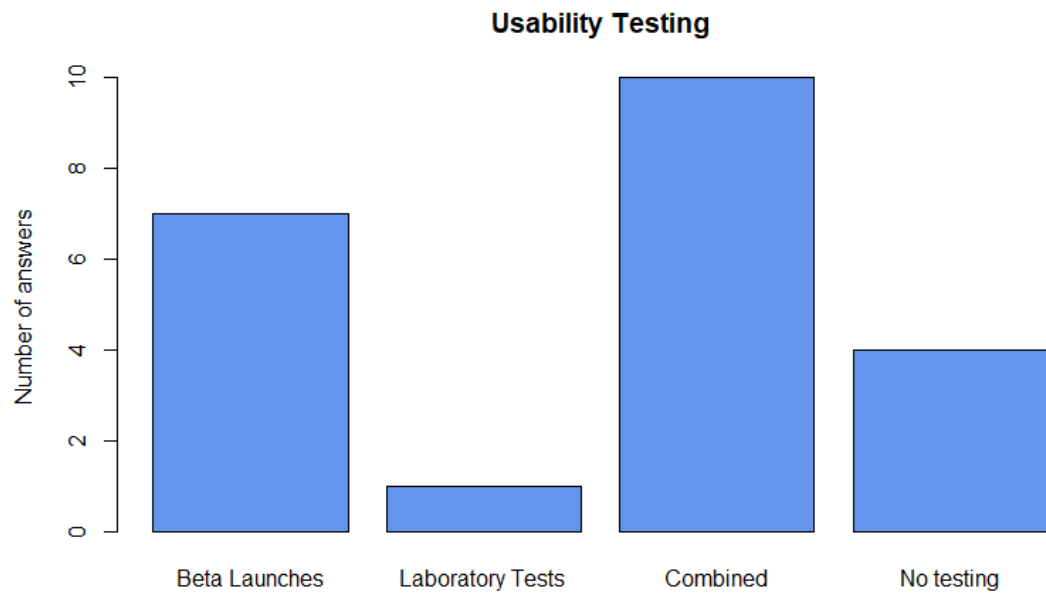


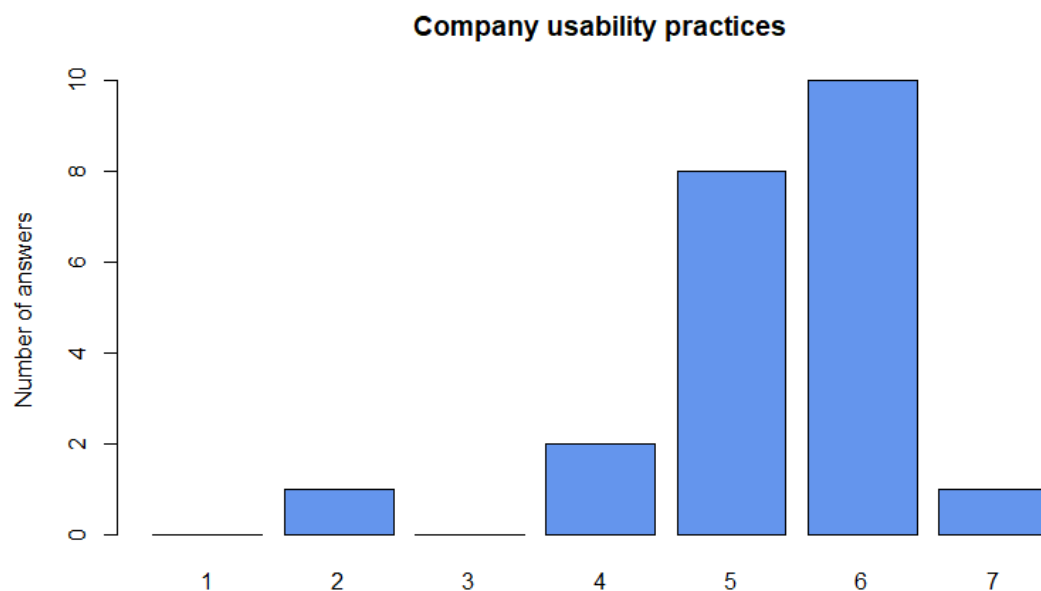
Figure 4: Usability testing.



Next phase in the questionnaire was to get some knowledge about usability practices in a company. Having a usability specialist in a company was surprisingly high. 77% reported that they had person specialized in usability. Testing is important to achieve good usability, so that was also discovered. Beta launches were the most common practice to test usability (77,3%). Only one answer was laboratory testing and 4 answered no testing. Combining both methods, beta testing and laboratory tests, however, was the dominant answer of all (Figure 4).

One of the questions was to find out how much company is focusing on usability. 50% answered that usability is important part of developing during the project, 27% that some planning and usability activities are used during developing and 23% that usability is taken into account but not on the focus. These results are interesting as the answers are divided. Mostly it seems usability activities go hand in hand during developing projects.

Figure 5: How developers rate usability practices in their company.



Many of the developers are feeling that their company's usability practices are good but not perfect (figure 5). Many of the literature sources were discussing about usability practices, Ehrlich & Rohn (1994), Rajanen (2006b), Karat (1994) and Rajanen & Iivari (2010). As many as 54,5% of the developers think that there could be improvement of usability practices in their company. Taking that into account, it is interesting that many developers rates usability practices as 6. However, a lot of answers in 5 as well.

Figure 6: How does developers think that good usability brings users or customers.

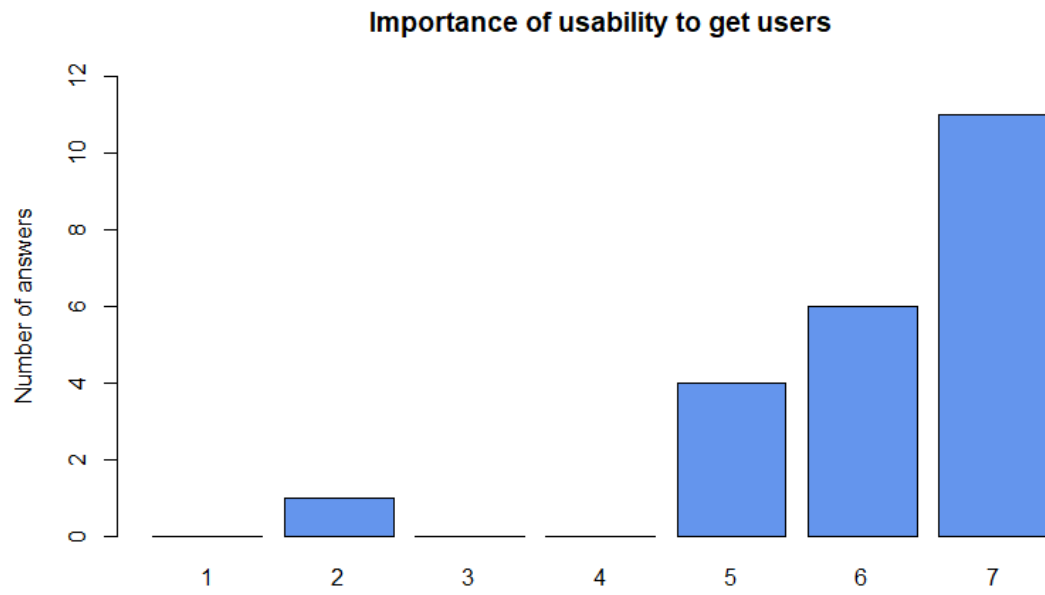


Figure 7: Does developers think that good usability reputation can be beneficial.

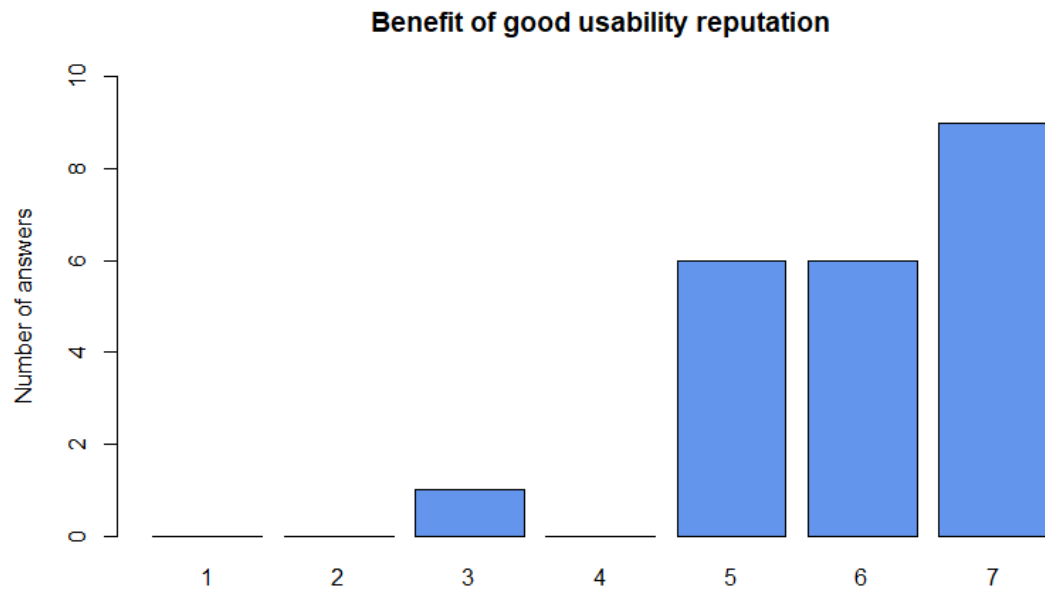
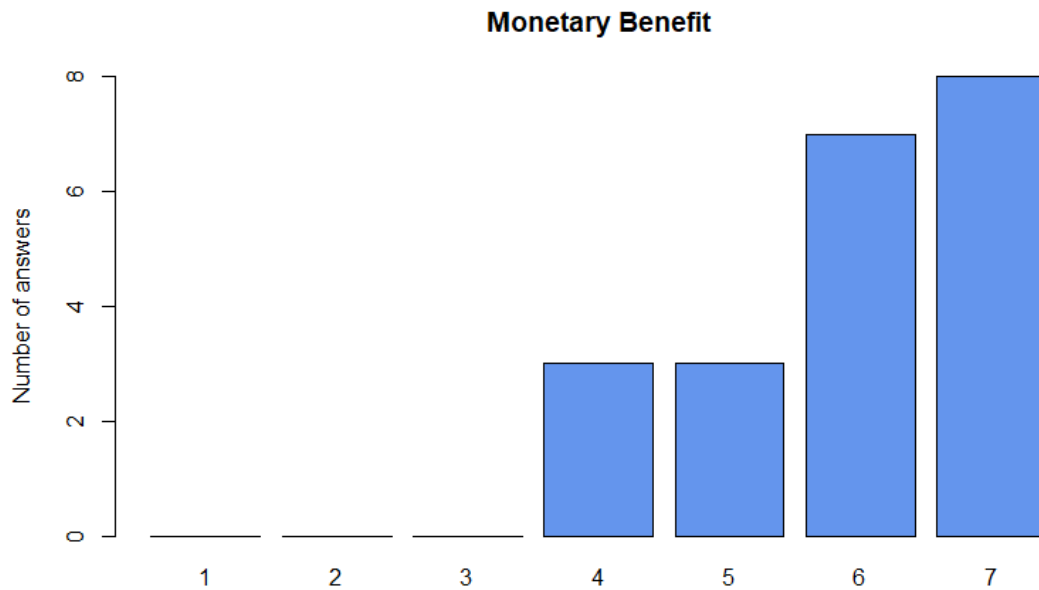


Figure 8: Does developers think that investing to usability can give monetary benefit?



Developers seem to think that usability is important to get users for their products and reputation of good usability is beneficial to their company (Figure 6, Figure 7). Questions are based on papers of Rajanen & Iivari (2007) and Rajanen (2010) that discuss about importance of good usability and benefit of good reputation. These results are pretty much as expected. However, some answer distribution. Some feel like usability is not completely important for getting users and to benefit company, but overall, developers seem to have a common view. Also, developers were mostly thinking that investing in good usability can give monetary benefit to their company (Figure 8). A lot of different authors were discussing about monetary benefits (see Appendix 1 & 2). Most answers are at 7 and 6 to agree monetary benefits can be gotten if company invest in usability. However, should notice that 4 & 5 has a lot of answers as well. So, results are not completely in agreement. None of the answers were not thinking it is not beneficial to invest in usability, but there were different opinions how valuable they rate monetary benefits from usability.

Figure 9: How does developers think that changes of usability increase workload in later phases of developing.

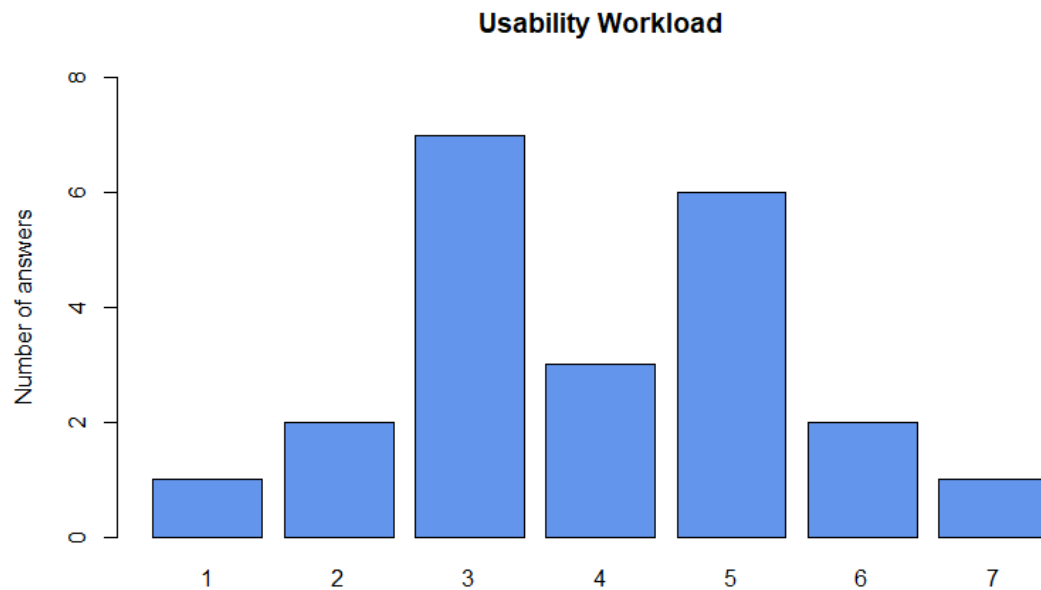


Figure 9 shows developer's feeling how usability changes to improve usability in later phases of developing feels to increase workload. This is common question in usability literature (For example, Rajanen & Iivari, 2010), how usability changes that had to be made in later phases increase workload and thus, important part of the questionnaire. Also, results are very interesting. Answer distribution is very high, but answers seem to be around middle of the scale most.

There are many variables to affect to the answers, like environment, which company a developer is working on and how much that company focus on usability, how well they do it, how much they invest to usability and finally, the answers are from individual persons that can have different view of which is a lot of workloads.

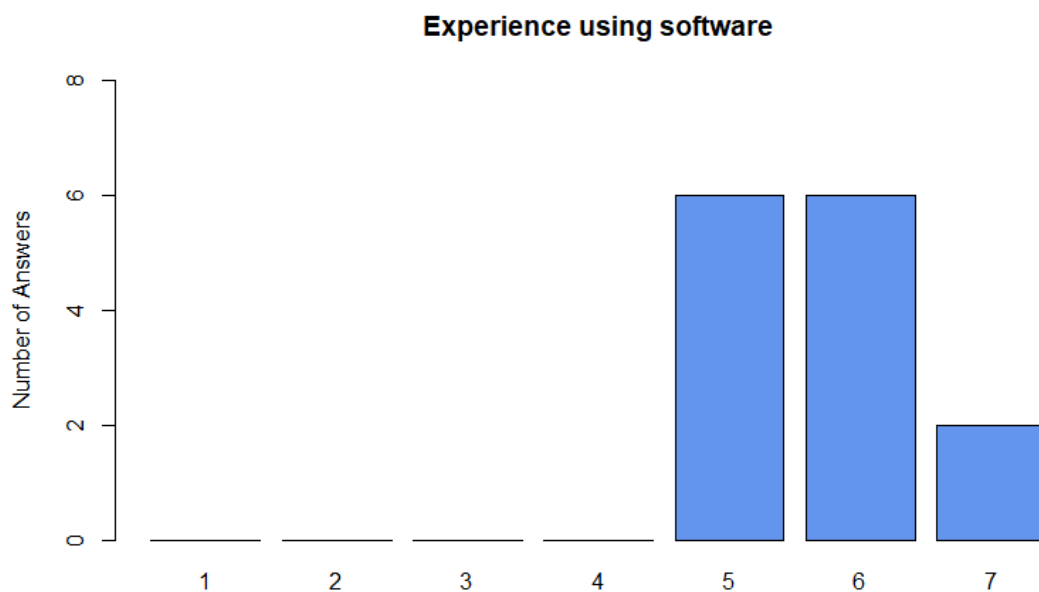
Question for that "do you feel that investing in usability is worth it" was 100% yes from the answers. Many of the questions seemed to have fairly common view among developers. As the results are showing, many of the answers were surprisingly similar. Many developers value usability and think it is important. However, there was some distribution between some of the answers too. Most importantly, how respondents valued different things.

4.2 Questionnaire results: End-users

For end-user questionnaire there were 14 answers. It is less than answers in developing organization questionnaire with 22 answers, but with the challenge to find respondents, 14 answers were considered enough close to the other questionnaire as a sample. The good thing though was that all answers are from different company. Thus, different software types used varied nicely in the answers.

85,7% said that they use different software at home that would not be necessarily needed. Only 14,3% said they do not use software that they did not necessarily need. Also, all the respondents felt they have experience at using different software (Figure 10).

Figure 10: Experience at using different software.



Question to “How important software usability is to you?” had common opinions. End-users clearly values good usability of software they use (figure 11). One important question for the topic is users’ opinion about usability in general, that they have experienced (figure 12). These results are interesting for that none of the answers are at rate 7. So, no one felt usability have been perfect in software users have used. Answers varies a bit but in overall it seems users have been happy with the usability. Also, 92,9% of the users agreed that usability affects to the software choice, when there is needed for a software. For example, usability specialist pointed out in paper of Rajanen & Iivari 2010 that if product costs as much as competitors and is much harder to use, why would anybody choose them.

Figure 11: How users rate importance of usability.

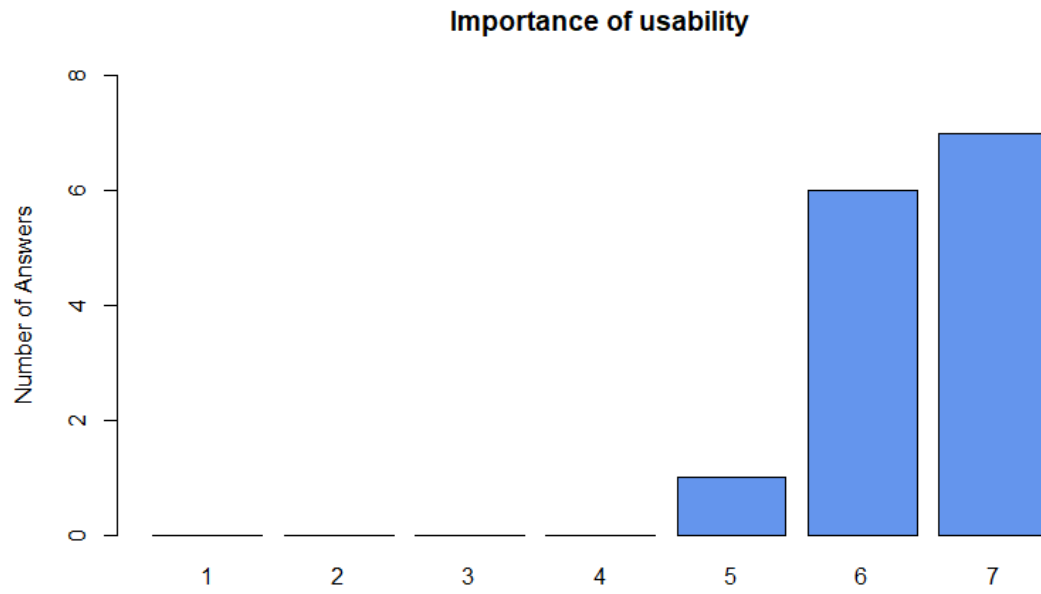


Figure 12: How users rate usability of software they have used.

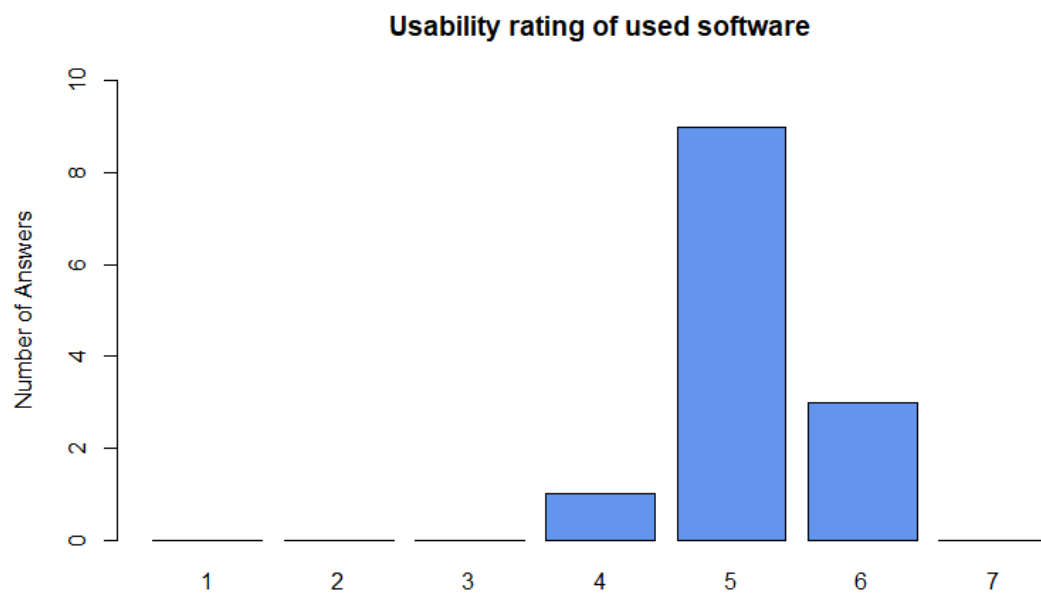
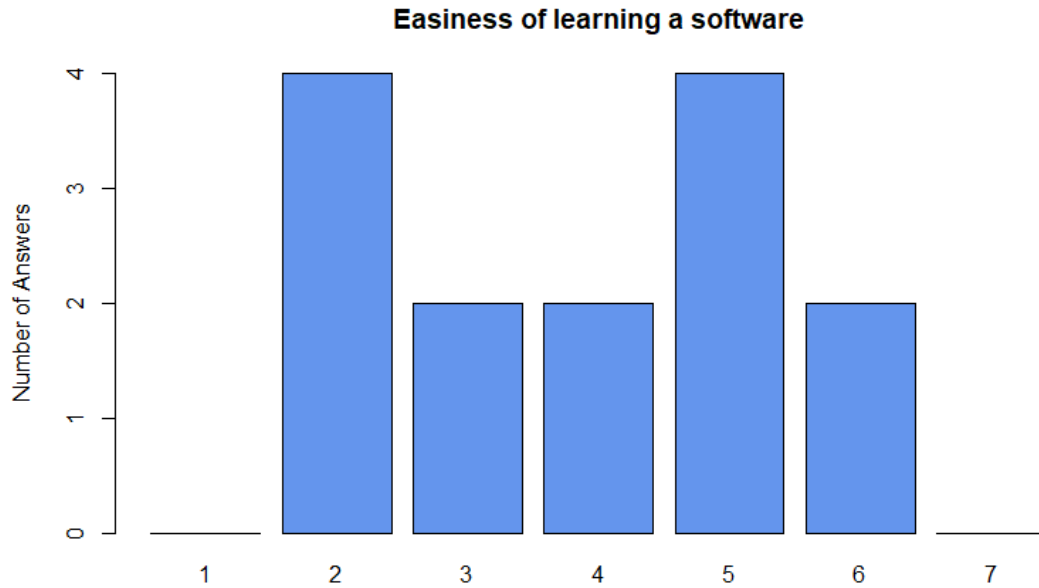
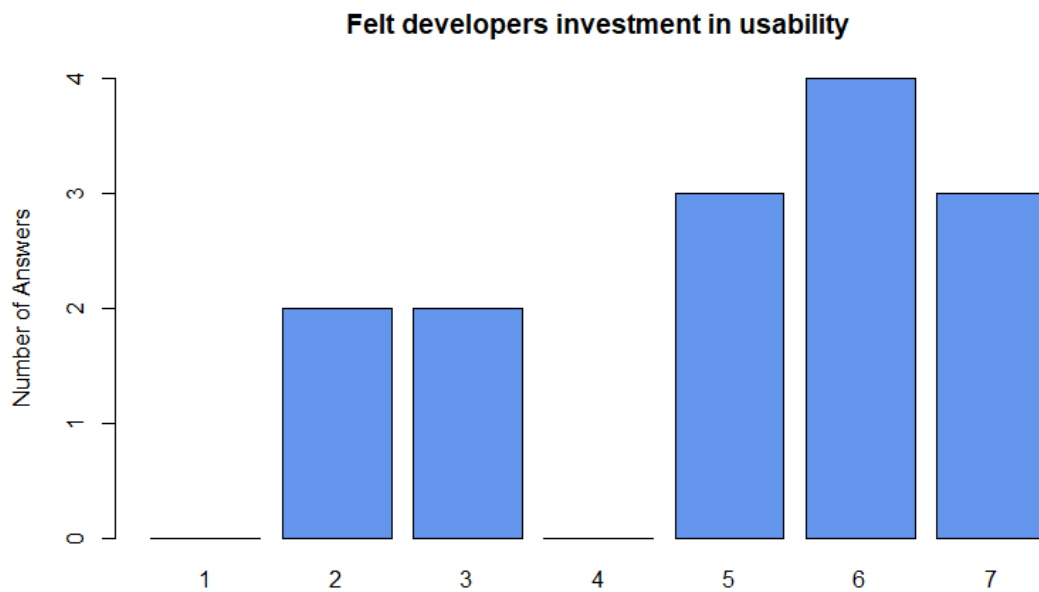


Figure 13: Users rating of easiness to learn a software.



The more specific questions started to get more diversity of the answers. For these questions, users answered basing to software they use in daily basis in their work. Easiness to learn a software was asked and the results vary (Figure 13). Learnability and usability often go hand in hand since if software is not understandable to the user, it is hard to learn it. For example, user interface can be messy, and some functionality might be hard to find or be deep in the menus. There is no clear dominant rating for the easiness to learn a software. Opinions vary from rating 2 to 6 evenly. Users don't feel it is extremely hard nor easy to learn a software though. All the users reported that they have had to seek help for a problem with software.

Figure 14: How users feel developers have invested in software they use.



For question “How much do you feel that developer of the software has invested in usability?” 71,4% of the answers were in rating range of 5 to 7 (Figure 14). Thus, opinion is mostly positive among users that developers invest in usability. But again, there is diversity. Two users were slightly negative and two not feeling that developers invest in usability enough.

One key question in end-user questionnaire is based to the literature about usability. Does usability reduce efficiency of working? In figure 15 it can be seen that the results are very widely divided. Rating 5 stands out as a single answer. Possible explain for diversity of the answers is that users have different software they use since all the answers are from different companies. So, some software might be better in usability than the others. Also, big factor is individual opinions that affects to the answer.

Figure 16 shows how satisfied users are with the software they use in their work in daily basis. For example, Ehrlich & Rohn (1994), Rajanen (2010) and Hassenzahl (2008) discuss about satisfaction of software use. The results show that even previous questions had different opinions, users are mostly happy with the software they use every day. Only one user is neutral about the matter and one user is not so satisfied to the software.

Figure 15: Does usability reduce efficiency of working?

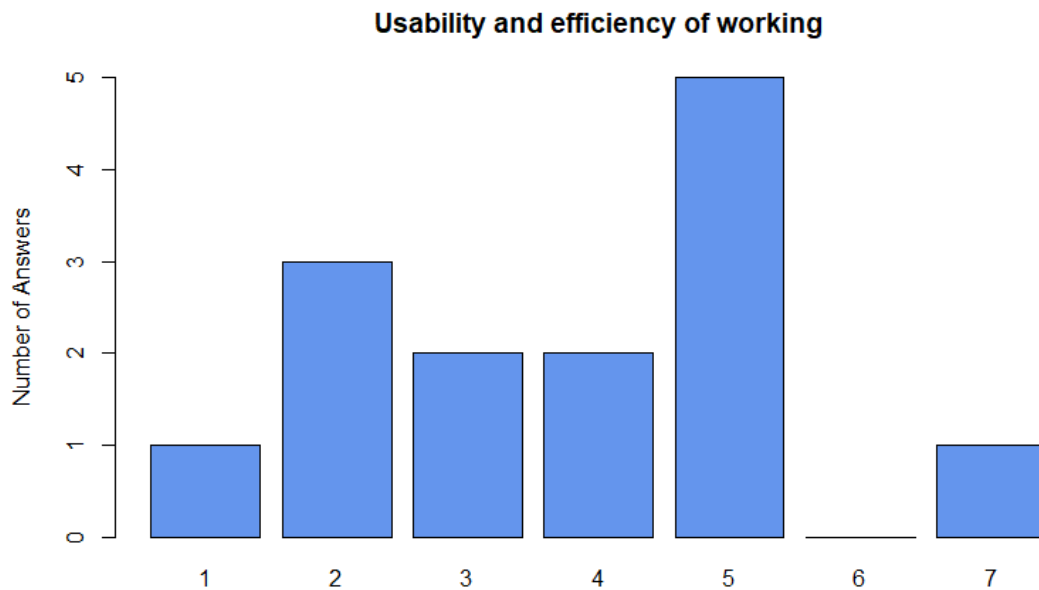
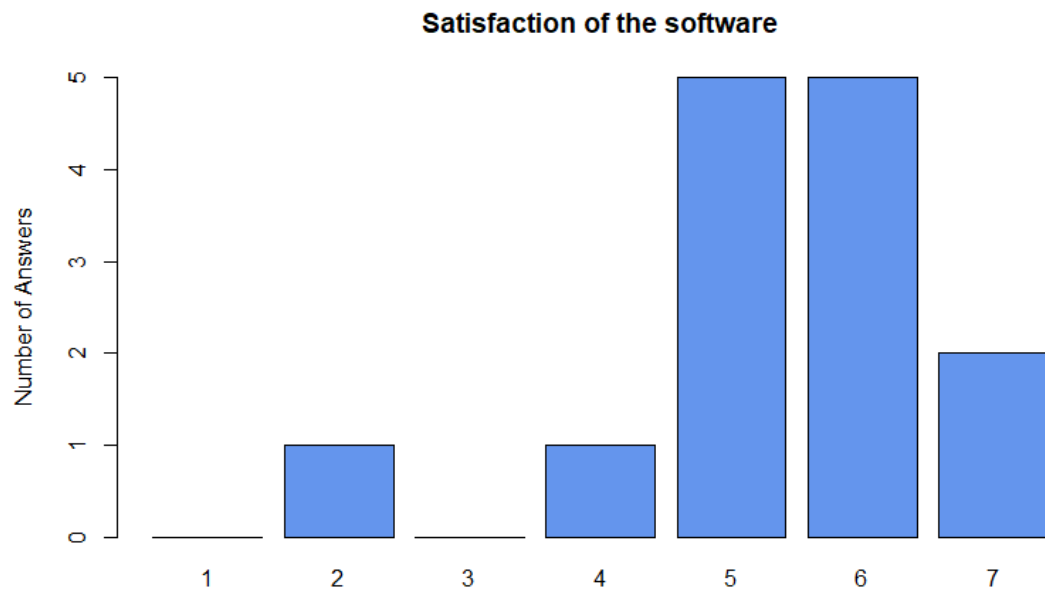


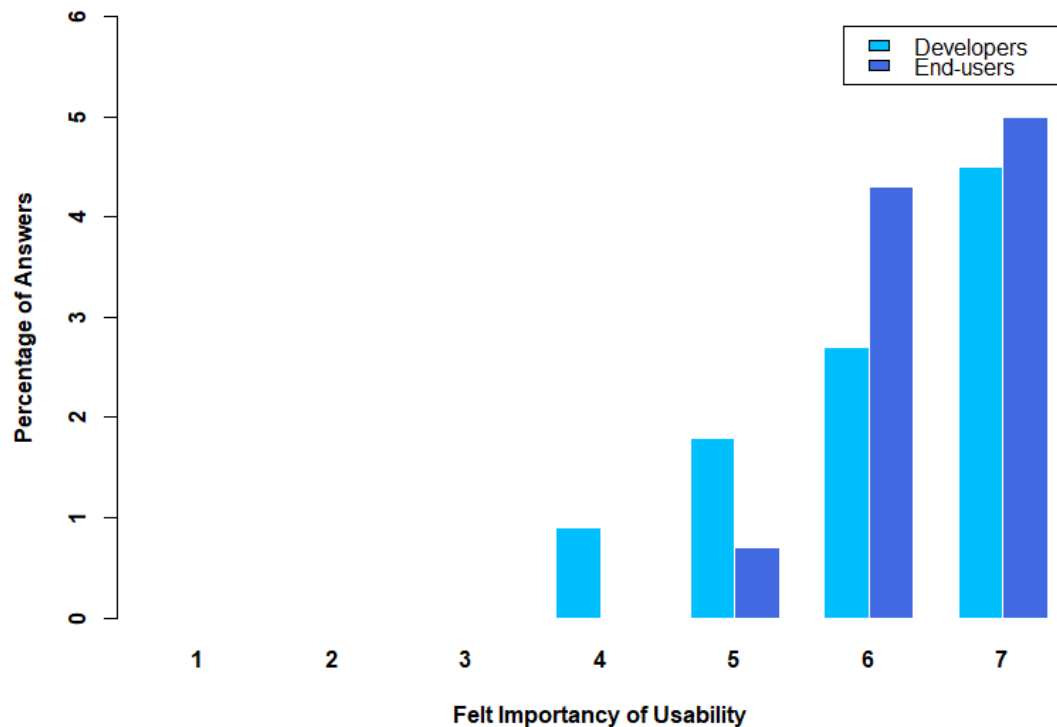
Figure 16: How satisfied users are with the software they use in daily basis.



4.3 Findings

Results of the questionnaires show that both developers and end-users feel that usability is important. Diagram below shows differences of the opinions between developers and end-users (Figure 17).

Figure 17: Difference of opinions about importance of usability between developers and end-users. Percentages are x10.



Ratings 6 and 7 are clearly most answered for both developers and users. Results shows that end-users feel that usability is more important than developers feel.

Interesting finding is that 77% of the developers answered having usability specialist in their company. However, only 50% of them had continuous usability focus during project. Some planning and usability activities were 27% of the answers. “Usability is taken into account but not on the focus” answer was 23% of the answers.

Developers overall were confident that usability in their company is in good shape as well as the results show that developers seem to value usability. Also, developers are positive that usability can benefit their company. For example, give monetary benefit to a company, attract more users and gain reputation. Neutral or negative answers for benefits were marginal. End-users had a common opinion that they are experienced at using software and usability of a software is important. Users are satisfied with usability generally but feeling that there could be improvement in usability of software. There were zero answers for “totally satisfied” and only three answers in second highest option. This correlate with developers who also say that there could be improvement in usability and usability practices in their company. Over half (54,5%) reported that there could be

improvement. Thus, both developers and users feel that there could be improvement in software usability.

Figure 18: Distribution of opinions between efficiency of working and overall satisfaction of software usage in daily basis.

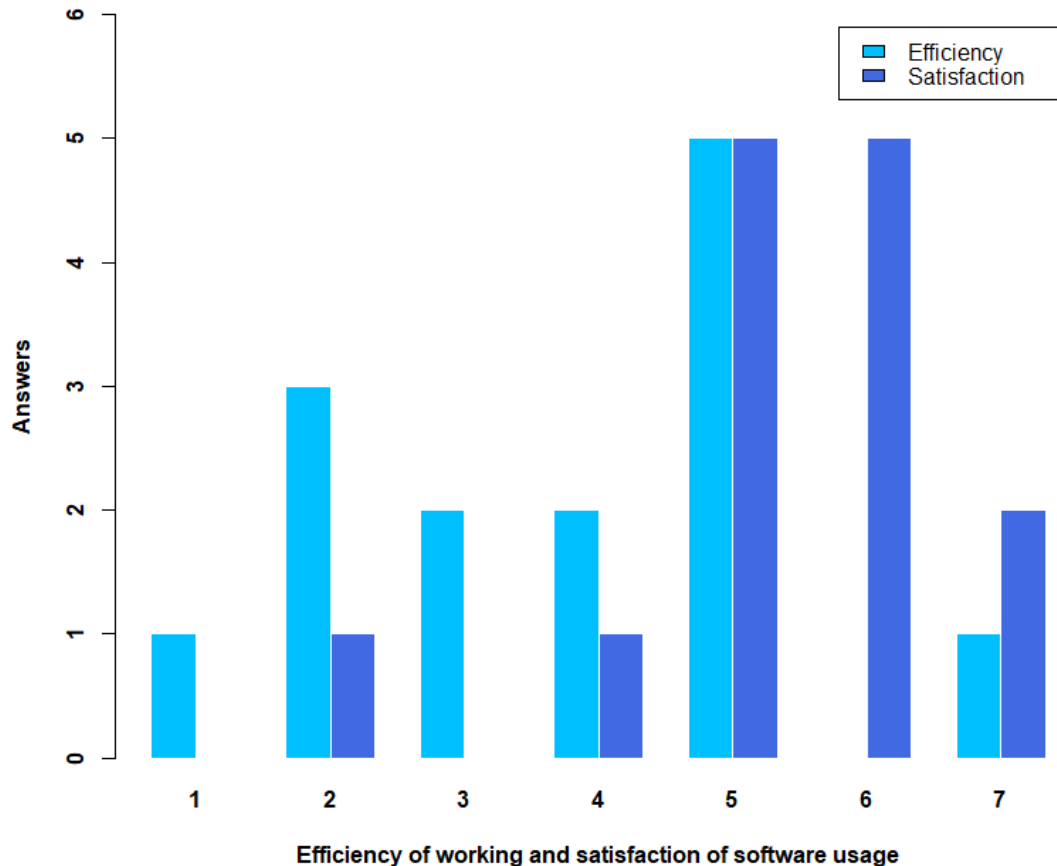


Diagram above shows distribution of satisfaction and working efficiency. Even users are satisfied with software they are using, many of them think usability is affecting to their work efficiency negatively. Over half of the answers (57,1%) are neutral or negative for working efficiency. Noticeable thing here is that lower ratings of opinions have gotten relatively high number of answers, unlike most of the questions where answers have quite similar opinions. Because of that, it seems that end-users have some problems using software or usability is not good enough. Comparing to that it is interesting that satisfaction of software usage is still rated so positively. Satisfaction of software usage for neutral and positive answers is as high as 92,8%.

Developer's open field answers had few factors that were discussed a lot. Majority of the developers pointed out that usability is not taken seriously enough (see Rajanen, 2011; Rajanen, 2006b) or usability activities are minimal for budget reasons (see Appendix 1, monetary benefits sources). For example, one of the answers was "*The first thing is still often to save time and resources at the expense of usability*". Was nice to see a lot of the answers discussed the things that are familiar from the usability literature. There were a lot of different developers saying that usability should be on focus at the start of a project and fixing usability in later phases of developing can be hard and expensive. Rajanen &

Iivari (2010) also discussed about it. For example, few answers were *“It is difficult to budget usability in, especially if it is not taken into account early on. I think usability is not easy to add in later”, “good usability is hard and expensive to add in later”* and *“It is important to notify usability already in planning phase, so implementing good usability is noticeably reducing costs”*. Many of developers also mentioned that usability is the first thing that customer and users want from a software. Another connection to the usability literature in the open answer field was that usability is important for the end-users to complete their tasks efficiently (Hornbæk, 2006; Hassenzahl, 2008). One thing that was not covered in this paper much and was mentioned by few answers was keeping the existing customers or users. Poor usability can be reason to stop using a software or application and lead for changing a software to be used. For example, one answer was discussing about costs and bad usability: *“Bad usability causes expenses because of fixing usability errors and slow response times. Also, bad usability can make user to stop using software or service, which can affect directly to the sales”*. One answer pointed out that *“developers don’t usually have knowledge about usability. Communication should be easy and efficient between developers and usability specialists as well as integrated to the development in regular basis”*.

Many of the end-users point out in the open field answers the importance of usability and learning a software. Problems mentioned are complex software, no helpful pop-ups or instructions about functionalities, that leads to another problem; Help and instructions must be sought from internet, forums, blogs or another sources of information. One end-user described usability as follows: *“Usability is one of the most important things in software. for example, response times, being clear and understandable are very important”*

5. Discussion

Usability is a complex topic and there is a lot of different variables that affect to the usability. Common definition of usability is effectiveness, efficiency and satisfaction in a specified context of use (ISO 13407). This study focused on these factors, but not limited for these. Usability is complex topic having mix of personal opinions and feelings, different companies have different focus on usability and different companies have different methods achieving that usability. This study has heavier focus on developing organizations and their methods. Many things as usability activities, way of thinking, weighting usability in company, testing practices and benefits of usability are all factors to pay attention when talking about usability. Some literature has shown that there are some developing companies that don't value usability high or think usability is not beneficial (Rajanen, 2011; Rajanen, 2006b). Also, some of the answers were supporting this. This is not to be generalized though. This thesis had highly positive approach towards usability by companies participating. In the questionnaire, it was clear that developers value usability as a *benefitable factor for their products and company*.

5.1 Limitations

There are some limitations in this research. Method is almost entirely quantitative. Only open fields in the questionnaires provides qualitative data. Interviews or way to have more individuals' opinions would fulfil the research better. However, method was limited to questionnaires and one open field answer because qualitative methods can have a lot of workloads and finding differences between developers and users view about usability could have been much harder.

About the questionnaire itself, larger pool of respondents would be better. Getting answers was challenging for the end-users, so answers were limited to 22 in developing organization questionnaire and 14 in end-user questionnaire. Opinion scaling was chosen to be from 1 to 7 since many sources prefer that scaling instead of 1 to 5. Open field answers were good source of material and opinions. Questionnaire could had more open field questions.

5.2 Future research

Open answers turned out to be valuable for results. I would suggest interviews or questionnaire with open questions to find out deeper knowledge how users or developers feel about usability and usability related topics. For example, does changes of usability increase workload in later phases of developing diagram (Figure 9) and Usability and its effect to efficiency of working diagram (Figure 15) had widely different answers, so open answers would have explained the reasons.

One possibility and for being too challenging research for this thesis, would be to contact development organization and find users of that organizations' products for a comparison. Interviews would be valuable in this method. Also, there could be few different organization-user cases (for example, 3 development organizations, 3 user group for their products).

6. Conclusions

This paper discusses about usability, its benefits and measure opinions between developing organizations and end-users. Thesis is based around usability literature and two questionnaires, one for developing organizations and other for end-users. There were 22 developers and 14 end-users answering to the questionnaires. Challenge to find end-users to take part in end-user questionnaire limited the sample slightly. However, the results offered good material to work on.

The result of the questionnaires shows that both developers and users value usability and its benefits. Answers towards questions relating to importance of usability and its benefits were highly positive and barely without negative rated answers. Problems with usability according to users were that software can be sometimes hard to learn or there are no instructions so often help must be sought from internet. Like forums, blogs or tutorial sites. Developers mentioned many problems that are familiar from usability literature. Sometimes usability is not taken seriously or company saves by not focusing on usability (see Rajanen, 2011; Rajanen, 2006b). Also, many developers mentioned that usability is not on focus at the start of the projects which makes fixing the problems and making better usability harder and expensive (see Rajanen & Iivari, 2010). Lacking usability activities and poor usability can lead to redesigns, less testing time for a software and bigger changes at later phases of developing can become impossible (Rajanen & Iivari, 2010). A lot of the developers suggested that usability should be incorporated at the start of a project. Developers were also aware that usability is important to the user and often the first thing user values. Some developers pointed out that keeping the users can be hard if usability is poor. Many of the users as well mentioned that they are ready to change a software they use for better usability. In addition, usability literature discusses about support costs, which mean that poor usability can lead to high support costs (Ehrlich & Rohn, 1994; Rajanen, 2011). Thus, saving from usability activities can cost later.

References

- Benson, C., Müller-Prove, M., & Mzourek, J. (2004). Professional usability in open source projects: GNOME, OpenOffice.org, NetBeans. *Extended Abstracts of the CHI2004*, 1083-1084.
- Bevan, N. (1995). Measuring usability as quality of use. *Software Quality Journal* 4, 115–150.
- Bevan, N. (2000). *Cost Benefit Analysis version 1.1. Trial Usability Maturity Process*. Serco
- Bevan, N., Carter, J., & Harker, S. (2015). ISO 9241-11 revised: What have we learnt about usability since 1998? In *International Conference on Human-Computer Interaction* (pp. 143-151). Springer International Publishing.
- J, Blow. (2004). *Game Development: Harder Than You Think: Ten or twenty years ago it was all fun and games. Now it's blood, sweat, and code*. Queue, Volume 1, Issue 10, February 2004, pp 28–37. <https://doi.org/10.1145/971564.971590>
- Burrill, C., & Ellsworth, L. (1980). *Modern Project Management: Foundations for Quality and Productivity*, Burrill-Ellsworth, New Jersey.
- Donahue, G. (2001). Usability and the Bottom Line. *IEEE Software*, Vol. 18(1), 31-37
- Ehrlich, K., Rohn, J. (1994). *Cost Justification of Usability Engineering: A Vendor's Perspective*.
- Hassenzahl, M. (2008). User Experience (UX): Towards an experiential perspective on product quality. *Proceedings of the 20th Conference on Interaction Homme-Machine*. Pages 11–15 <https://doi.org/10.1145/1512714.1512717>.
- Hornbæk, Kasper. (2006). Current practice in measuring usability: Challenges to usability studies and research. *Int. J. Human-Computer Studies* 64 (2006) 79–102
- ISO. (1998). *Ergonomic requirements for office work with visual display terminals (VDTs)-Part 11: guidance on usability—Part 11: guidance on usability (ISO 9241-11:1998)*.
- ISO 13407. (1999). *Human-centered design processes for interactive systems*. International standard.
- ISO/IEC 9126: *Software engineering - product quality* (1991)
- ISO 9241-11: *Ergonomic requirements for office work with visual display terminals (VDTs) - Part 11 Guidance on usability* (1998)
- Karat, C-M. (1994). *A Business Case Approach to Usability Cost Justification*.
- Kohno, I., Yasu, H., Sugawara, S., & Nishikawa, M. (2013). *Pragmatic Approach to Cost Benefit Analysis of User Centered Design*. A. Marcus (Ed.): DUXU/HCI 2013, Part I, LNCS 8012, pp. 525–534, 2013. © Springer-Verlag Berlin Heidelberg 2013

- Mayhew, D., Mantei, M. (1994). A Basic Framework for Cost-Justifying Usability Engineering. In Bias, R., Mayhew, D. Cost-Justifying Usability. Academic Press. 1994. pp 9-43.
- Maguire, M. (2001). Methods to support human-centered design. *International journal of human-computer studies*, 55(4), 587-634.
- Ohnemus, K. (1996). "Incorporating Human Factors in the System Development Life Cycle: Marketing and Management Approaches", IPCC96.
- Rajanen, M. (2006a). Different Approaches to Usability Cost-Benefit Analysis. The 13th European Conference on Information Technology Evaluation.
- Rajanen, M. (2006b), "Applying Usability Cost-Benefit Models to Nanotechnology Tools Development", TNT project report, Oulu, Finland.
- Rajanen, M. (2011). Applying usability cost-benefit analysis-explorations in commercial and open source software development contexts. *Acta Universitatis Ouluensis, Ser. A, Scient. rerum nat.* 587 (2011).
- Rajanen, M. (2020). Usability Cost-Benefit Analysis for Information Technology Applications and Decision Making. In E. Idemudia (Ed.), *Information Technology Application for Strategic Competitive Advantage and Decision Making*. IGL Global. DOI:10.4018/978-1-7998-3351-2.ch008.
- Rajanen, M. (2021). De Gustibus Non Est Disputandum, but Usability is Not a Matter of Taste. 7th International Workshop on Socio-Technical Perspective in IS development (STPIS 2021) 11-12 October 2021, Trento, Italy.
- Rajanen, M., & Iivari, N. (2007). Usability Cost-Benefit Analysis: How Usability Became a Curse Word? *Proceedings of the 11th IFIP TC 13 Conference* (pp. 511–524). Springer-Verlag: Berlin.
- Rajanen, M., & Iivari, N. (2010). Traditional usability costs and benefits – fitting them into open-source software development. 18th European Conference on Information Systems.
- Rajanen, M., & Nissinen, J. (2015). A Survey of Game Usability Practices in Northern European Game Companies. *IRIS: Selected Papers of the Information Systems Research Seminar in Scandinavia*. Issue Nr 6. Paper 8. <http://aisel.aisnet.org/iris2015/8>
- Rajanen, M., & Rajanen, D. (2017). Usability Benefits in Gamification. *GamiFIN Conference 2017*, Pori, Finland, May 9-10, 2017
- Raymond, E. (1999). *The Cathedral & the Bazaar: Musing on Linux and Open Source by an Accidental Revolutionary*. O'Reilly & Assoc.
- Rosson, M., & Carroll, J. (2002). *Usability Engineering: Scenario-based Development of Human Computer Interaction*. Morgan-Kaufman, San Francisco
- Shackel, B. (1991). Usability—context, framework, definition, design and evaluation. In: Shackel, B., Richardson, S. (Eds.), *Human Factors for Informatics Usability*. Cambridge University Press, Cambridge, pp. 21–38.

Williams, C. (2007). Research Methods. *Journal of Business & Economics Research (JBER)*, 5(3). <https://doi.org/10.19030/jber.v5i3.2532>

7. Appendices

Appendix 2. Questions: Developing Organizations

Appendix 3. Questions: End-Users

Appendix 4. Answers: Developing Organizations

Appendix 5. Answers: End-Users

Appendix 1. Questions: Developing Organizations

Question	Literature source
Size of the company?	No specific source
Type of software developed?	No specific source
How important you feel usability of developed products is to your company?	Rajanen, 2006b; Rajanen, 2011
Does your company have a person who is specialized in usability?	Rajanen & Iivari, 2010
Does your company do usability tests with users?	No specific source
How much effort is used for usability of developed product?	No specific source
How would you rate the usability practice in your company?	Ehrlich & Rohn, 1994; Rajanen, 2006b; Karat, 1994; Rajanen & Iivari, 2010
Do you feel usability practices at the moment are good enough in your company?	Ehrlich & Rohn, 1994; Rajanen, 2006b; Karat, 1994; Rajanen & Iivari, 2010
How big factor you think good usability is for getting users or customers?	Rajanen & Iivari, 2007; Rajanen, 2010
How beneficial would you think that good "reputation" of good usability can be?	Rajanen & Iivari, 2007; Rajanen, 2010
Do you feel that the changes of the software to improve usability increases the workload in the later phases of developing?	Rajanen & Iivari, 2010
Do you think investing in usability can give monetary benefit for the company?	Rajanen & Iivari, 2007; Rajanen & Rajanen, 2017; Burrill & Ellsworth 1980; Karat, 1994; Mayhew & Mantei, 1994; Donahue, 2001; Bevan, 2000; Ehrlich & Rohn, 1994
In overall, do you feel investing in usability is worth it?	No specific source
Open field	No specific source

Appendix 2. Questions: End-Users

Question	Literature source
Do you use software that are not necessarily needed at home?	No specific source
How experienced you feel you are using different software?	No specific source
How important software usability is to you?	No specific source
In general, how would you rate usability of software you have used?	No specific source
When you need a software for some purpose, does usability affect your choice of software?	Rajanen & Iivari, 2010
Software type used?	No specific source
How would you rate easiness of learning to use that software?	Hornbæk, 2006
How much do you feel that developer of the software has invested in usability?	No specific source
Has there been a situation with the software where you have had to seek help for a problem?	No specific source
Do you feel that usability of the software is reducing efficiency of working?	Ehrlich & Rohn, 1994; Karat, 1994; Bevan, 2000; Rajanen, 2010; Hassenzahl, 2008; Hornbæk, 2006
How satisfied you are using software in daily basis?	Ehrlich & Rohn, 1994; Rajanen, 2010; Hassenzahl, 2008; Hornbæk, 2006
Open field	No specific source

Appendix 3. Answers: Developing Organizations

Size of the company?	Type of software developed?	How important you feel usability of products is to your company?	Does your company have a person who is responsible for usability?	Does your company do usability tests with users?	How much effort is used for usability of developed product?	How would you rate usability practice in your company?	Do you feel usability practices at the highest level of your company?	How big factor you think good usability is for getting users or customers?	How beneficial would you think good usability is for your company?	Do you feel that the changes of usability increases the productivity in the later phases of development?	Do you think investing in usability can increase monetary benefit for the company?	In overall, do you feel investing in usability is worth it?
Small (few offices in one city)	Web application	4	No / EI	Beta launches	Usability is important part of developing	5	Yes	5	5	4	3	Yes
International	Web application, Software/ System software, Application, Software development tool, Embedded systems, Security Software, Cloud	7	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Usability is important part of developing	6	No, there could be improvement	7	7	5	7	Yes
International	Web application, Software/ System software, Application, Embedded systems, Cloud	7	No / EI	Beta launches, Laboratory tests where user is observed	Usability is important part of developing	5	Yes	5	3	5	7	Yes
International	Web application, Software/ System software, Application, Software development tool, Embedded systems, Security Software, Cloud, Enterprise resource planning	4	No / EI	Beta launches, Laboratory tests where user is observed	Usability is taken into account but not on the focus	2	No, there could be improvement	7	7	3	7	Yes
Medium (offices around the country)	Web application, Software/ System software, Application, Cloud	5	Yes / Kyvia	Laboratory tests where user is observed	Some planning and usability activities used during developing	5	No, there could be improvement	6	5	3	5	Yes
International	Web application, Software	7	Yes / Kyvia	No	Usability is taken into account but not on the focus	4	No, there could be improvement	6	5	3	4	Yes
International	Web application	7	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Usability is important part of developing	7	Yes	7	5	4	6	Yes
Large (many or large offices around the country)	Software/ System software, Application	5	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Usability is important part of developing	6	Yes	6	7	6	7	Yes
Medium (offices around the country)	Web application, Application, Embedded systems	6	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Some planning and usability activities used during developing	6	Yes	7	6	3	5	Yes
Medium (offices around the country)	Web application, Software, Application, Embedded systems, Cloud	7	Yes / Kyvia	No	Usability is important part of developing	6	No, there could be improvement	7	7	2	6	Yes
Medium (offices around the country)	Application	6	Yes / Kyvia	No	Usability is important part of developing	6	Yes	5	5	5	6	Yes
International	Web application, Software/ System software, Application, Cloud	7	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Usability is important part of developing	6	Yes	7	7	3	7	Yes
Large (many or large offices around the country)	Web application, Software/ System software, Application, Embedded systems, Cloud	6	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Usability is important part of developing	5	No, there could be improvement	7	6	3	4	Yes
Small (offices in one city)	Web application, Application, Cloud	6	No / EI	Beta launches, Laboratory tests where user is observed	Some planning and usability activities used during developing	5	Yes	5	6	5	6	Yes
International	Web application, Software/ System software, Application, Software development tool, Embedded systems, Cloud	7	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Usability is important part of developing	6	No, there could be improvement	7	6	4	6	Yes
Medium (offices around the country)	Web application, Software/ System software, Application, Embedded systems, Cloud	7	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Usability is important part of developing	6	No, there could be improvement	7	7	5	7	Yes
Small (offices in one city)	Web application, System software, Embedded systems, Cloud	7	No / EI	Beta launches	Some planning and usability activities used during developing	4	No, there could be improvement	6	5	2	6	Yes
International	Web application, Cloud	6	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Usability is important part of developing	6	Yes	7	7	6	7	Yes
Medium (offices around the country)	Web application, Software/ System software, Application, Embedded systems	5	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Usability is taken into account but not on the focus	5	No, there could be improvement	6	6	3	5	Yes
International	Web application, Software/ System software, Application, Embedded systems, Cloud	5	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Some planning and usability activities used during developing	5	No, there could be improvement	6	7	1	7	Yes
Medium (offices around the country)	Web application, Software/ System software, Application, Embedded systems	6	Yes / Kyvia	Beta launches, Laboratory tests where user is observed	Usability is important part of developing	6	Yes	7	6	7	6	Yes
Large (many or large offices around the country)	Web application, Software/ System software, Application, Embedded systems, Cloud	7	Yes / Kyvia	No	Usability is taken into account but not on the focus	5	No, there could be improvement	2	7	5	4	Yes

Appendix 4. Answers: End-Users

Do you use software that are not necessarily needed at home?	How experienced you are using different software?	How important software usability is to you?	In general, how would you rate usability of software you have used?	When you need a software for some purpose, does usability affect your choice of software?	Software type used?	How would you rate easiness of learning to use that software?	How much do you feel that developer of the software has invested in usability?	Has there been a situation with the software where you have had to seek help for a problem?	Do you feel that usability of the software is reducing efficiency of working?	How satisfied you are using software in daily basis?
Yes	6	7	4	Yes	Web application	2	7	Yes	2	6
No	5	6	6	Yes	Software	5	6	Yes	4	6
Yes	5	7	5	Yes	System software	2	5	Yes	3	5
No	5	7	5	Yes	System software	5	5	Yes	5	5
Yes	5	5	5	Yes	System software	2	3	Yes	7	2
Yes	6	7	6	Yes	Cloud software	5	5	Yes	5	4
Yes	5	7	5	Yes	Statistical software	3	2	Yes	1	6
Yes	7	6	5	No	Software	4	7	Yes	3	5
Yes	6	6	6	Yes	Software	4	7	Yes	2	7
Yes	6	7	5	Yes	Software	6	6	Yes	5	6
Yes	5	7	5	Yes	Web application	6	6	Yes	4	6
Yes	6	6	5	Yes	Cloud	5	2	Yes	5	5
Yes	7	6	5	Yes	Web application	2	6	Yes	2	7
Yes	6	6	4	Yes	Web application	3	3	Yes	5	5