Tampere University

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GETTING TO KNOW THE USERS

Improving documentation usability through heuristics and user personas

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ABSTRACT

Hanna Fränti: Getting to know the users: Improving documentation usability through heuristics and user personas
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The purpose of this thesis is to study how heuristic expert evaluation and user personas could be utilized together to improve the usability of technical documentation. The study outlines what kind of information the two methods can produce about the users and compares them to see if supplemental benefits can be achieved by combining them. This study was commissioned by a company which provided all the material that was used.

Theoretical background of this study centers around users and usability, and they are viewed from the perspective of technical communication. It also covers strengths and weaknesses of both methods used in this study. To use heuristic evaluation to learn about users, I created a new way of utilizing it, *inscription-based heuristic evaluation*. I used it to analyze 20 technical documents and evaluated the inscribed user in the documentation. In addition, I conducted 13 user interviews and created five user personas based on the interview data. I compared the results to identify the differences between the two methods and assessed what kind of benefits combining them would yield.

The results indicate that the two methods indeed produce different types of information about the user. Information gained through inscription-based heuristic evaluation is connected to different knowledge levels and purposes a user can have. User personas produced detailed information about ways the real users utilize the documentation, how their personal preferences affect it, and what kind of problems they typically face with the documentation.

The results suggest that combining these two methods would be beneficial. A tool which addresses both the users' needs and features in documentation would allow a more user-centric approach to documentation and lay the foundations for improved usability. Further studies comparing different ways of combining heuristic evaluation and user personas could illuminate this even more.

Keywords: usability, heuristic expert evaluation, user persona, technical documentation, user

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Tässä tutkielmassa tarkastellaan heuristista asiantuntija-arviointia ja käyttäjäpersoonia sekä tutkitaan, millaista tietoa ne tuottavat käyttäjistä. Tutkielman tavoite on selvittää, tuottavatko nämä kaksi menetelmää erilaista tietoa ja voisiko niiden yhdistämisestä olla apua käytettävyyden parantamisessa. Tämä tutkielma tehtiin yhteistyössä sen toimeksiantaneen yrityksen kanssa. Kaikki tutkimuksessa käytetty materiaali saatiin yrityksen kautta.

Tutkielman tieteellisenä viitekehyksenä toimii käytettävyys ja käyttäjä, joita tarkastellaan teknisen viestinnän näkökulmasta. Viitekehyksen puitteissa käydään läpi myös kummankin tutkielmassa käytettävän käytettävyysmetodin vahvuudet ja heikkoudet. Jotta heuristinen arviointi tuottaisi tietoa sen käyttäjistä, kehitin uuden tavan hyödyntää sitä. Kutsun tätä nimellä *sisäänkirjoitettuihin käyttäjiin perustuva heuristinen arviointi*. Analysoin sen avulla 20 teknistä dokumenttia ja arvioin niihin sisäänkirjoitettuja käyttäjiä. Haastattelin lisäksi 13 käyttäjää ja loin keräämieni tietojen pohjalta viisi käyttäjäpersoonaa. Vertailin kummankin menetelmän avulla saatuja tuloksia voidakseni tunnistaa niiden välillä olevat erot ja arvioida, tuottaisiko niiden yhdistäminen hyötyä, jota vain yhtä metodia käyttämällä ei saavutettaisi.

Tulokset viittaavat siihen, että nämä kaksi menetelmään todellakin tuottavat erilaista tietoa käyttäjistä. Sisäänkirjoitettuihin käyttäjiin perustuva heuristinen arviointi tuotti tietoa sisäänkirjoitettujen käyttäjien erilaisista tietotasoista ja tarkoitusperistä. Käyttäjäpersoonat puolestaan kertoivat tavoista, joilla todelliset käyttäjät hyödyntävät dokumentaatiota. Se valotti myös sitä, miten käyttäjien yksilölliset mieltymykset vaikuttivat käyttötapoihin ja sitä, millaisia ongelmia käyttäjät tyypillisesti kohtasivat dokumentaation kanssa.

Tutkielman tulokset viittaavatkin siihen, että heuristisen asiantuntija-arvioinnin ja käyttäjäpersoonien yhdistäminen olisi hyödyllistä. Työkalu, joka kattaisi paitsi käyttäjien tarpeet, myös ne ominaisuudet dokumentaatiossa, jotka parhaiten tukevat niitä, voisi oikein käytettynä luoda hyvän pohjan dokumentaation käytettävyyden parantamiselle. Tätä voisi tutkia tarkemmin esimerkiksi vertailemalla eri tapoja yhdistää heuristinen asiantuntija-arviointi ja käyttäjäpersoonat, ja se voisi paljastaa uutta tietoa siitä, millä tavalla yhdistettynä ne tuottaisivat parhaimpia tuloksia.

Avainsanat: käytettävyys, heuristinen asiantuntija-arviointi, käyttäjäpersoona, tekninen dokumentaatio, käyttäjä

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1 Introduction

Usability is one of the core concepts to consider when developing new products or services. This aspect is of special importance in technical communication as well, as technical documentation is not only an important part of the product itself (SFS-EN 82079-1 2020), but also one of the direct channels of communication between the developers and the users. Different methods for evaluating and improving usability have been created over time. One of them is heuristic expert evaluation, in which the evaluators examine and judge the product's compliance with a set of usability principles (Nielsen 1993, 155). In this study, I will refer to it simply as *heuristic evaluation*. Another method that is used to improve usability is the creation of user personas. User personas are fictional user architypes which illustrate how users may want to interact with the product (Long 2009, n.p.) Although both focus on improving usability, their emphases are a bit different. They have both been studied quite extensively, so there is a lot of information to utilize. This study will focus on these two methods in the context of improving usability of technical documentation.

Heuristic evaluation is a very popular usability evaluation method, as it is quick, cheap, and easy, but it has been criticized for its performance and reliability (Chattratichart and Lindgaard 2008, 2213). When conducting heuristic evaluation, the evaluators can often forget to consider the abilities and expertise of different types of users, which makes heuristic evaluation usually system-oriented rather than task- and user-oriented (Chisnell et al. 2006, 47). It has been suggested that usability heuristics could be applied in a more user-centric manner, if user personas were defined first (Dantin 2005). This seems like a reasonable assumption, as studies have suggested that user personas aim the focus more on the users' needs (Long, 2009). Hence, utilizing them together would help the evaluator to conduct the heuristic evaluation from a more user-centric point of view, which in turn could provide more useful information that could be utilized for improved usability.

In her study Erin Friess (2015) touches upon the possibility of combining heuristic evaluation and user personas. She compared two different ways of utilizing personas with heuristic evaluation and observed if they had different effect on the confidence of the evaluators conducting the heuristic evaluation. The personas and usability heuristics have also been utilized together by first using the heuristic approach as a more general method to increase the understanding of important concepts and then user personas have been used for getting a more detailed image of the needs of the end-user (Kneale, et al., 2017). However, even though the utilization of heuristic evaluation and user personas together has been present in some studies, the aspect of methodologically comparing the two methods to discover the best methodology for the combination has not been addressed. Although Friess (2015) had two slightly different ways of combining heuristic evaluation and user personas, they both applied the finished personas in similar ways: simply by keeping personas in mind during the heuristic evaluation. Chisnell et al. (2017, 48) state that their approach was to "channel" the personas and conduct the heuristic evaluation in character while providing verbal commentary about their thoughts. Dantin (2005, n.p.) only mentions that the task logic and ease of use was evaluated separately for each persona but does not outline how this was conducted. Despite the different methods for the combinations, the results have been encouraging both in regard to user-centricity (Friess 2015, 189) and understanding of quality issues (Dantin 2005, n.p.).

The reason behind the decisions to choose these ways of combining the two methods may be that, as stated earlier, heuristic evaluation produces typically system-oriented usability information and user personas focus heavily on the user experience. This means that it can be difficult to compare the information between the methods. However, heuristic evaluation is rather flexible in its procedure, which allows the heuristics to be used in different ways and to different extents (Hertzum and Jabobsen 2001, 435). This means that heuristic evaluation can be modified to produce information about the users so that the results can be more easily compared with user personas.

The objective of this study is to observe what kind of information about the user can be gained with heuristic evaluation and user personas, and then compare the results. The aim is to find possible differences between the information they produce, which can be in turn used to evaluate, how could these two methods be best combined to make technical documentation more user-friendly. My research questions are:

- Do results regarding the user differ depending on whether heuristic evaluation or user personas are utilized? If they do, what kind of differences can be observed?
- Would utilizing these methods together create supplemental benefits? If so, what kind of benefits?

All prior studies view the combinations of these two methods in the context of user interfaces or web pages. I will address them from the point of view of technical communication to see, if similar benefits could be gained in the context of technical documentation as well. I will approach these questions by creating a new way of utilizing heuristic evaluation so that it produces information about the users. I call it *inscription-based heuristic evaluation* as it utilizes the concept of *inscription*. Inscription is a process during which the creator's conscious and unconscious assumptions about the user are transferred to the final product via small decisions made during the process (Akrich 2000, 208). Inscription-based heuristic evaluation is used to decode these assumptions in technical documentation. In this study I will use two methods and two sets of data. Firstly, I will evaluate 20 technical documents provided by a company which commissioned this study. Secondly, I will create the user personas, which are based on 13 interviews conducted on the actual users of this company's documentation. Lastly, I compare these results and evaluate if combining the two methods would be beneficial and attempt to find out how they could be best combined in regard to the information they produce.

In chapter 2 I will introduce the theoretical background, which is used in this study. I will address the basic notion of usability in general and from the point of view of technical communication. I will also introduce the theories behind heuristic evaluation and user personas. In

chapter 3 I will introduce the data and methods utilized in this study. The data consists of documentation provided by the company that commissioned this study and the interviews I conducted on the users of this documentation. I will also explain in more detail, how I developed inscription-based heuristic evaluation and explain how I will be using it in this study. I will illustrate the process behind the creation of user personas and explain what kind of factors will be given most prevalence. I will also explain, what is the goal of the comparative analysis used to assess the differences between the two methods. In chapter 4 I will report the results. Firstly, I will go through the results from the heuristic evaluation, secondly, I will introduce the user personas, and finally I will compare the results. In chapter 5 I will conclude my findings and provide suggestions for possible future studies.

2 Usability

Usability is the main aspect behind this study and thus all the methods as well as the analysis will be intertwined with it. In short, *usability* means "capability of being used" (Bevan et al. 2015, 143). However, it can sometimes be defined in very different ways: it can have a very broad definition which equals it to quality in use, or a narrower one which distinguishes it from related terms such as *utility* (Frøkjær et al. 2000, 345). In this study I will use *usability* to refer to the narrower definition. This definition views it as a part of the more general acceptability (Nielsen 1993, 25), as seen in Figure 1.

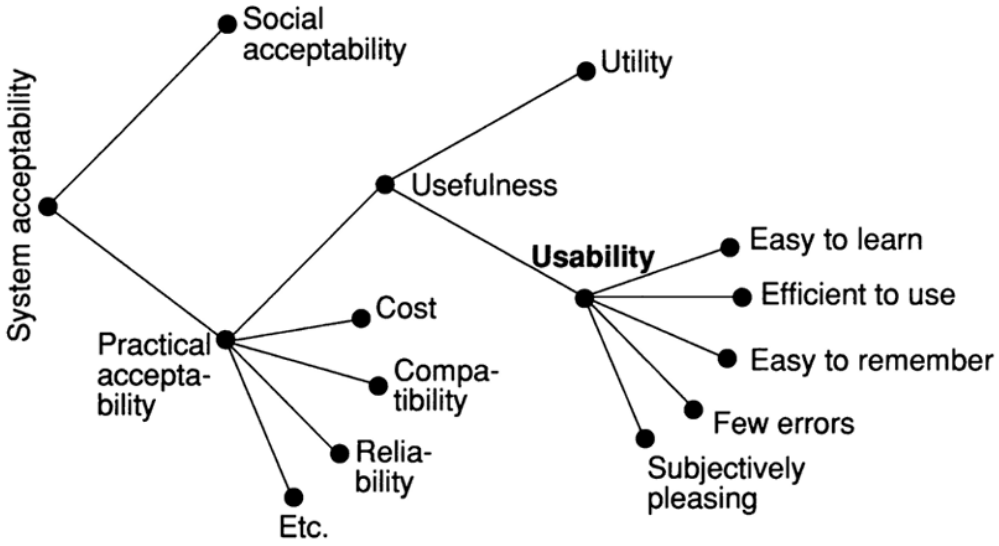

Figure 1. System acceptability consists of multiple interlinked factors (figure by Nielsen 1993, 25).

Nielsen (1993, 25) divides this overall acceptability into social and practical acceptability. Social acceptability is its own branch and its main aspects are social ones: does the product follow ethical standards and do people accept it and its functions. Practical acceptability includes various factors, such as cost, compatibility, reliability, and usefulness (ibid.). Usefulness in turn consists of utility – which assesses if the product works as it should – and usability, which focuses more on how well users succeed in using the product. Even though it is only a part of overall acceptability, usability is applicable to all different aspects of a product with which the user might come in contact (ibid.).

Usability as a concept started to gain importance in the early 1990s (Hollingsed and Novick 2007, 249), as due to technological advancements more and more people started to use complex products frequently both in their personal and professional lives (Nielsen 1993, 8). Since then, the idea of usability has evolved and diversified into placing even more emphasis on the importance of understanding the user and of collaborating between different fields to best utilize the usability insights (Lund 2006, 4–5).

One notable usability pioneer is Jakob Nielsen, whose work was important in the birth of usability as a profession (Dumas 2007, 57). He divided usability into five categories that emphasize its different aspects: learnability, efficiency, memorability, errors, and satisfaction (Nielsen 1993, 25). Learnability refers to how easy it is for a new user to learn to use a product and it is often depicted in a form of a learning curve, as the learning process is usually gradual and happens over a longer period of time (ibid., 27–28). Efficiency refers to the performance level the users can achieve once they have learned to use the product well (ibid., 30). Usually it is measured by observing how long it takes for the more experienced users to perform specific tasks (ibid., 30-31). Memorability refers to users' ability to recollect how to use a product after they have not been using it for a while (Nielsen 2012, n.p.). Errors are another aspect of usability; not only the number of errors matters but it is also important to take notice how severe impacts the errors have (Nielsen 1993, 32). Higher number of small errors from which the use can easily recover can often be preferable than few catastrophic errors that prevent the user from utilizing the product at all. Satisfaction on the other hand refers to users' experiences of using the product: how pleasant it is (Nielsen 2012, n.p.). Especially with systems that have an entertainment value, such as games, satisfaction is an important factor regarding usability (Nielsen 1993, 33). Nevertheless, it can be argued that if satisfaction of using a product is low and competing products are available, the users may choose to try a different product next time.

Not all definitions of usability include all these five aspects. For example, the International Organization for Standardization (2018) defines usability as "the extent to which a system, product, or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". In contrast to earlier standards, this new revision recognizes usability as an outcome rather than a property of a product and places more importance on user experience (Bevan et al. 2015, 143). In this new ISO definition usability is viewed from the point of view of *effectiveness*, *efficiency*, and *satisfaction*, out of which *effectiveness* is not even among the aspects listed by Nielsen.

Despite dividing usability aspects into separate entities, they are very often intertwined with one another: a product that is easy to learn and has few severe errors is also probably more satisfying for the users. However, it might also be difficult or even impossible to create a product that accommodates all different customer needs in every aspect (Nielsen 1993, 42). For example, while it is recommendable to acknowledge users and their opinions regarding a product, users might not always understand what kind of solutions they would like the best or what would be most useful for them – especially if they need to imagine using a product that is not familiar to them (ibid., 12). These kinds of conflicts between different aspects of usability force the developers and companies to decide which usability aspects they wish to prioritize in each situation (ibid., 42).

By operationalizing these types of different aspects of usability, we can measure them and use this information to assess the level of overall usability, because usability itself cannot be directly measured (Hornbæk 2006, 80). For example, we can measure the errors made by the user in a specified period of time. Even with these measures as an aid, measuring overall usability is not straightforward, as it can be questioned how well each measure indicates usability and, to complicate things new suggestions for measures of usability continue to emerge (ibid.).

Many methods have been designed to study these measurable aspects in order to gain understanding on the overall usability of a product. Different methods focus on different usability

aspects and some may view user's presence mandatory, while other see that a product and its usability can be evaluated to some extent even without any direct output from a user (Fernandez, et al. 2011, 790). Usability evaluation methods can be divided into four main groups: models/metrics, testing, inspection, and inquiry (Zhang 2006, 210). Usability models/metrics measure a certain aspect of a product (ibid., 211) and typically a program or other tool is used to gather this data automatically (ibid.). Their benefits relate to the relative ease in which it can be automated and its weaknesses to the fact that it may be difficult to prove that the data gathered correlates with the product usability in any way (ibid., 210). Usability testing is conducted by having users perform typical tasks using the product or product prototype while being observed by the evaluator (ibid., 217). It is often considered one of the most fundamental methods of gaining information about usability (Nielsen 1993, 165), but it and other techniques that require somewhat complex understanding or preparations may not always be a possibility (ibid., 17). Usability inspection includes a variety of methods such as different types of walkthroughs and variants of heuristic evaluation (Zhang 2006, 216). Unlike usability testing, usability inspection can be conducted without involving users, as usability experts are utilized for reviewing the product and observing potential usability problems (ibid. 210). In usability inquiries evaluators collect information about users' experiences with the product by either talking to them or by observing them using the product (ibid., 213). They also include multiple different methods from questionnaires and interviews to focus groups and field observation (ibid.).

Several studies suggest that improved usability is linked to cost savings (Nielsen 1993, 2) and it plays an important role in managing potential risks regarding inappropriate outcomes of interaction (Bevan et al. 2015, 143). Nevertheless, many companies prefer to choose some of the more affordable options for assessing usability, such as heuristic evaluation instead of more complicated ones, such as usability testing (Nielsen 1993, 17). This is not inherently a negative thing, but it simply means that the more comprehensive and expensive methods might not be

practical in every situation (ibid.). It is always necessary to weigh in the benefits and the weaknesses when trying to select the best suited usability evaluation method for each situation (Jeffries et al. 1991, 124).

In addition to specific usability evaluation methods, there are also other things which are not directly classified as usability aspects but which nevertheless affect usability. User experience (UX) and usability are different concepts, but they share a number of similarities while also influencing one another (Chestnut and Nichols 2014, 13). What differentiates UX from usability is that its focus lies on the overall experience a user has when using a product, including feelings, thoughts, and perceptions (Tullis and Albert 2013, 5). As one of the usability aspects – satisfaction – is clearly related to the concept of user experience, UX metrics might be useful also when tackling usability problems, especially if the goal is to increase user satisfaction. Also, different approaches to a design process may affect usability in various ways. One very popular approach is user-centered design (UCD), which emphasizes the role of users in a design process (Miaskiewicz and Kozar 2011, 417). User personas are widely utilized in UCD (ibid., 418) and they are sometimes also used as a tool during usability assessment, since understanding who the users are and what their needs are is fundamental to usability (Nielsen 1993, 73). This accompanied with the widely increasing emphasis on user experience are the reasons why users will be the focus in this study as well.

General usability principles can be applied to the usability of documents, although there are some notable differences between the usability of technical documentation and usability of systems. Usable document can be defined as an “error free document, presented in an easy-to-use manner, with complete and accurate information” (Jayaprakash 2008, 245). Fulfilling these requirements does not, however, necessarily result in usable technical documentation: if the intended audience does not match the actual users, they may have problems understanding and using the technical documentation (ibid.). This is one of the issues that I attempt to tackle in this study by introducing a combination of two usability methods so that these factors can be addressed.

The way of presenting information in a document is something that needs to be considered carefully, as it may affect the users' understanding of the information or the importance they assign to it (Hamlin et al. 2016, 98). Also, when technical documentation is good, it complements the product and helps to reduce support costs (Jayaprakash 2008, 230). However, users often seem to discard the use of technical documentation that would help them in their problems (Novick and Ward 2006b, 12). A study conducted on the attitudes towards technical documentation concluded that although users see some positive sides especially in online documentation, they often see manuals as hard to navigate, hard to understand, and too basic to be useful (ibid., 16). Another study surveyed users' hopes regarding technical documentation and provided a list of properties users value the most (Novick and Ward 2006a, 86-88):

- Easy navigation
- Problem-oriented organization
- Complete, correct, and comprehensive information
- Convenient presentation
- Explanations with suitable level of complexity

Implications of these studies highlight again the importance of knowing the users and also the necessity of accommodating different user needs (Novick and Ward 2006a, 90). This goes well together with the overall shift in usability during the last decades: user-centered design and user experience have gained prominence (Redish 2010, 196) and usability experts have concluded that in addition to understanding users' needs, it is also necessary to learn to understand factors that shape these subjective attitudes, motivations, and experiences (Lund 2006, 5).

2.1 Usability heuristics

One way of assessing usability is to utilize usability heuristics. Usability heuristics are a set of somewhat flexible rules that are used to assess, how usable a product is and what usability problems it has (Nielsen 1993, 115). In this study, I will utilize usability heuristics to conduct heuristic evaluation. These methods are described in further detail in section 3.1.2.

After usability heuristics were first introduced, they have been revised and further adapted and adjusted for multiple different purposes (Nielsen 2005, n.p.), such as video games (Joyce 2019) and technical documentation (Purho 2000). If these different sets of heuristics are compared, it becomes evident that some of the original heuristics are included in modified sets of heuristics more often than others. This might be explained by the fact that the original heuristics were developed for evaluating the usability of user interfaces, so some of them might not be as easily applicable to other type of products, such as technical documentation. Below I will introduce Purho's (2000) set of ten heuristics for technical documentation, as I will use them in this study (see section 3.1.2.). These heuristics are:

1. **Match between documentation and the real world**
   The language that is used to describe a product should be familiar to the users.

2. **Match between documentation and the product**
   The language used in documentation should correspond with the product.

3. **Purposeful documentation**
   In situations when the product information is provided in multiple documents or information items the form and content of each document needs to be purposeful and the division of information into multiple documents must be well-grounded and logical.

4. **Support for different users**
   Different types of users and their needs for different type of amount of information should be acknowledged, if possible. This is possible for example by hiding information that is not necessary to all users or by providing quick reference information for expert users.

5. **Effective information design**
   Information should be designed in a way that allows necessary bits of information to be easily found and understood.

6. **Support for various methods for searching information**
   Different users may prefer to use different methods in order to find pertinent information. This means that documentation should accommodate these different methods by providing information about the document structure and contents, for example by using content tables, indexes, meta-data, and visualizations.

7. **Task orientation**
   It is important to provide information that is structured around the task the user needs to perform and support the user's performance as well as possible. This requires the documentation to be applicable in the conditions the task takes place and to provide appropriate level and amount of information.

8. **Troubleshooting**
   There should be a separate section for troubleshooting, which gives users information about the most common problems and helps them to overcome them. This section as well as all information relating to errors must be easily found and accessible.

9. **Consistency and standards**
   Any documentation should follow either local or global documentation standards. This means that terminology, structure, and editorial style should be used consistently throughout the document.

10. **Help in using documentation**
    Sometimes – especially if the document or documentation set is especially large – it is necessary to explain to the user what the purpose of the document is and how to navigate it to find information.

Heuristics can be used either during the design process or a finished product can be assessed in heuristic evaluation using heuristics as a checklist (Nielsen 1992, 373). In this way, Purho's (2000) heuristics can help technical writers during the writing process but they can also be used for evaluating the usability of existing documentation. When usability heuristics are used as a checklist each list item represents one of the usability principles and it is then compared to the system to see if it is fulfilled (ibid.). Usability heuristics were originally developed in 1990 by Jakob Nielsen and Rolf Molich for heuristic evaluation of user interfaces (Hertzum and Jacobsen 2001, 422).

Heuristic evaluation is one of the most popular usability inspection methods (Chattratichart and Lindgaard 2008, 2213). In heuristic evaluation, the evaluator uses a set of guidelines – heuristics – to estimate if some aspects of the product are likely to cause usability problems (Jeffries et al 1991, 119). Since its first introduction the basic principle has remained the same, but the method has been refined through the years to better answer the different needs regarding usability in various fields (Hollingsed and Novick, 2007, 249-250).

The popularity of heuristic evaluation is based on the simplicity of the method: it is easy and quick to carry out, and it is cost-efficient when compared to other inspection methods (Chattratichart and Lindgaard 2008, 2213). In a study which compared four different usability evaluation methods, heuristic evaluation was concluded to have produced the best results and at the lowest cost (Jeffries et al. 1991, 123). Another study stated that while the level with which the real

users agreed with the results of heuristic evaluation was only medium, the results suggested that there are specific types of problems for which the heuristic evaluation is especially suitable (Khajouei et al. 2018, 17). These were often problems relating to errors, such as issues with recognizing and diagnosing them, as well as recovering from them (ibid., 15). Errors also happened to constitute the greatest number of user-reported problems in this study (ibid.), so it further highlights the benefits of heuristic evaluation. There are also different variants of heuristic evaluation available, such as persona-based heuristic evaluation and HE-Plus, which focuses on a specific set of problematic areas (Chattratichart and Lindgaard 2008, 2214). Applying these variants appropriately in right circumstances helps to improve both the performance and reliability of heuristic evaluation (ibid., 2219).

Like all usability evaluation methods, heuristic evaluation is not without its weaknesses. Studies suggest that it may lead to unreliable results with false alarms and missed usability problems (Chattratichart and Lindgaard 2008, 2214). Its simplicity also has a downside: although almost anybody can use heuristic evaluation, the informality of this method means that a lot of weight is placed on the evaluator (Hertzum and Jacobsen 2001, 424). Several studies have shown that this often leads to drastically different results between different evaluators not only regarding cosmetic or low-severity issues, but also many severe problems (ibid., 432). There is also a big difference, whether the evaluator is a novice or an expert (Nielsen 1992, 373), or whether they are working alone or with other evaluators (Nielsen 1993, 156). However, these issues are not solely inherent to heuristic evaluation, but many other usability evaluation methods suffer from similar shortcomings (Hertzum and Jacobsen 2001, 427). Also, simply conducting heuristic evaluation with multiple evaluators will significantly increase the reliability of the results (ibid., 430).

However, as the study by Hertzum and Jacobsen (2001, 434) identified the principal reasons behind evaluator effect, they managed to provide guidance for avoiding the typical shortcomings of heuristic evaluation (ibid., 434). Three problematic aspects include: vague goal analyses, vague

evaluation procedures, and vague problem criteria (ibid.). Setting a clear goal and verifying the expected coverage before starting the evaluation will help to keep the evaluator's focus on relevant features, and if multiple evaluators are used, this will ensure that they all have the same definite goal (ibid., 434-435). In heuristic evaluation this can be done simply by mentally clarifying the outcome of the goal (ibid., 434). Vague evaluation process is due to the deliberate feature of heuristic evaluation: heuristics can be used in different ways and to different extents (ibid., 435). This can be countered by creating a more systematic procedure for the evaluation to ensure that all necessary elements are evaluated through similar process against all heuristics (ibid.). The third typical problem for heuristic evaluation is that different evaluators may sometimes disagree whether an issue should be considered as a usability problem or not (ibid., 437). This can be covered by providing criteria which define when an issue should be seen as a usability problem, so that all evaluators will categorize them in a similar manner (ibid., 437-438). As I will be the only evaluator in the heuristic evaluation in this study, I hope that by following these suggestions, I manage to increase the reliability of the results.

Despite its possible shortcomings, heuristic evaluation yields important information with relatively little effort, and it continues to be used in variety of projects (Hollingsed and Novick, 2007, 250). Also, some studies – such as by Friess (2015), Chisnell et al. (2017), and Dantin (2005) – have combined heuristic evaluation with user personas. The aim has been to make heuristic evaluation more user centric (Friess 2015, 189), which can be seen as relating to the growing emphasis on the user in regard to usability.

2.2 User personas

User personas are the second aspect regarding usability that is assessed in this study. User persona is a detailed – yet fictional – description of an archetypal user (Harley 2015, n.p.). The description is written as if the persona was real, and it includes different types of information not only to

captivate the relevant user characteristics but also to make the persona seem like a real person (ibid.). Usually this information includes background information such as age, gender, occupation, and behavior, as well as information about this persona's needs, motivations, and goals (ibid.). To make them more tangible, user personas usually also include a photo and sometimes a quote or a motto to encapsulate this persona's distinct personality and attitude (ibid.). Figure 2 presents a simple example of a user persona which includes goals, interests, and frustrations, as well as a name, an age, and a photo.

Figure 2. Simple user persona.

User personas can be very useful during the design process. Although the goal of creating a product is usually to make something that customers need, want, and are willing to pay money for, it is very difficult to create a truly user-centric development process (Pruit and Adlin 2006, 5-6). There are three major reasons for this: firstly, it is more intuitive for people to see things from their own perspective; secondly, users are not all the same but complicated and varied, and thirdly, even if there is information about users, it might not be available to the designers (ibid., 6). Utilizing user personas can help to tackle these problems, as they can convey complicated concepts relating to users in a more understandable and memorable way (Harley 2015, n.p.). This is due to the fact that humans innately identify themselves even with fictional characters, which makes it easier for them to understand the behavior of others (Grudin 2006, 644). Utilizing this natural human feature can provide a better way of communicating user-related information with the design team, which can enable them to focus more effectively on the needs of the users (Miaskiewicz and Kozar 2011, 419).

The results gained with the utilization of user personas depend on the way they are created: if the data used to create them is not sufficient or if the personas are based only on assumptions or

clichés, the results might not be as good and the personas might even lead the focus away from the real needs of the target users (Marshall et al. 2015, 312). However, user personas do not necessarily need to be detailed or data-driven to yield results: even an assumption-based persona created in couple of hours can be useful (Pruit and Adlin 2006, 167–168). There are also other possible obstacles that can decrease the potential benefits achieved by user personas, such as lack of intra-organizational support, poor communication, and lack of understanding how personas could be best utilized (Adlin and Pruit 2010, 2). One approach to tackle these problems is to use the "persona lifecycle" approach, which illuminates different aspects of the entire persona process (ibid.). These phases cover everything from planning the process and creating the personas to introducing them to the organization, putting them into use, as well as estimating their success and conducting a plan to either reuse or retire them (ibid.). The creation process itself can be broken into separate steps (Pruit and Adlin 2006, 165). One part of my study is the creation of user personas and I will utilize these steps to conduct it. This creation process is addressed in further detail in chapter 3.2. The steps for creating user personas are (ibid.):

1. Identifying important user categories
2. Processing data relating to users
3. Using the processed data to create persona skeletons for different user categories
4. Prioritizing the persona skeletons
5. Developing the selected persona skeletons into fully fleshed out personas
6. Validating that the final personas still reflect the data

Even when these steps are followed, the process can be actualized in very different ways, depending on the time available for it, the amount of data about the users, and the goals set for the persona utilization (Pruit and Adlin 2006, 166). Many this type of organization-specific factors need to be taken into account during the planning phase, which is also the time when it should be determined, what kind of user personas would best fit both the organization and the project (Adlin and Pruit 2010, 9).

3 Data and methods

In this chapter I will introduce the data and methods which are used to analyze and further utilize the data. All data is provided by or acquired in cooperation with the technology company who commissioned this case study, and it consists of technical documentation and user interviews. After, these results will be subjected to comparative analysis. Three different methods will be used in this study to analyze the data:

- Heuristic evaluation of technical documentation
- Creation of user personas through semi-structured interviews
- Comparative analysis between the heuristic evaluation and the user personas

In the following subsections I will describe the data and explain the methods in further detail, by first introducing the heuristic evaluation, then user personas, and finally the comparative analysis.

3.1 Heuristic expert evaluation

I will use heuristic evaluation to analyze technical documentation created for a specific delivery project, and in this section I will first introduce the technical documentation and then define my way of using heuristic evaluation in this study.

3.1.1 Technical documentation

Within the company that commissioned this case study, each project has its own documentation set, which consists of several documents of multiple different document types. The project-specific documentation set is designed to cover all aspects of the product, including everything from delivery documents and system descriptions to mechanical and electrical installation instructions and to user guides and maintenance instructions.

The company produces modular electro-mechanical products, and the deliveries often consist of multiple separate entities combined into a final product. This is why the documentation set is also divided into smaller parts, which are then further divided into categories and subcategories. The

main division is mostly based on different product parts within the delivery, such as generators, control panels, and interface units. The project I chose for this case study culminated in the delivery of a final product, but I will only focus on the documents relating to one of the electro-mechanical modules. The choice to limit the material to this module was due to the extreme size of this delivery project. The project was concluded during autumn 2019, when the documentation set was also finalized and sent to the customers.

In total, the documentation set for this module in this delivery project consists of 202 different documents, which include several document types. The main categories in this module are:

- General
- Mechanical
- Electrical
- Installation

All documents in these main categories are further divided into subcategories that illustrate the purpose of these documents even more in detail. These 32 subcategories relate more specifically to certain features in this module (such as different systems), certain phases in manufacturing (such as installing a specific part), or certain document type subtypes (such as safety instructions).

There are altogether 17 different document types in this documentation set, and the 202 documents can be divided roughly into text and image-based documents to gain a better understanding on their overall differences. This division is based on the format of the document: although the text-based documents do have images as well, they are placed among the text; similarly, the image-based documents have text, but it is placed within the images. There are 87 text-based documents and 115 image-based documents. The document types for the text-based documents are:

- Function description
- Installation instruction
- Instruction
- Maintenance instruction
- Operating instruction
- Parts list
- Requirement specification
- Signal list
- System description
- Technical regulation
- Technical specification
- User manual

The image-based document types on the other hand consist of the following:

- Graphic
- Panel layout
- Pre-planning
- Schematic multi-line
- Schematic single-line

I will focus my attention on the text-based documents for two reasons. The first reason is that they are much better suited for this type of heuristic evaluation than the image-based ones. This is mostly due to the nature of the image-based documents included in the delivery project: they contain detailed technical information for a very special purpose and their form is therefore likely to adhere to strict structural conventions. Panel layouts are a good example for this: they consist of an image of a device or concept, and either name the parts that it consists of or simply provide information about the dimensions. These kinds of images have very high information density and little or no text is required to guide the user. As the goal of this study is to use heuristic expert evaluation to observe what kind of user emerges from it, this type of technical documentation is not likely to provide useful information. For a very similar reason, I also decided to exclude document types that consist of lists alone: *signal list* and *parts list*.

The second reason for excluding the image-based documents is that some of their document types (including circuit diagrams and other schematics) demand expertise on electrical engineering in order to understand them beyond surface level. This kind of knowledge is not part of my field, so it would be very difficult for me to use heuristic evaluation on them to gain any kind of useful information about the intended users. In addition to this, the number of the text-based documents is more than sufficient. Apart from the lists, all the other text-based document types were selected to be part of the heuristic evaluation.

Even with image-based documents excluded, the number of documents was still far too high, so to select the most suitable documents out of these for the heuristic evaluation, two exploratory interviews were conducted to determine, if some specific documents or document types were considered to be more important than others. The interviewees consisted of company personnel that worked closely with the product. Neither of the interviewees saw any single document to be more

or less important than any other. They both also held the opinion that there were no unnecessary documents: every single one of them was in some way crucial for the delivery – though different user groups might have specific types of technical documentation that are especially important for them. Nevertheless, it was mentioned that safety instructions in general should stand out from the documentation set and that function and system descriptions were perhaps the most central document types in this project.

Based on the exclusion of image-based documents and lists, as well as on the information gained from the interviews, I selected twenty different documents to be examined in the heuristic evaluation. I took categories (main categories as well as subcategories) into account, as well as different document types, when conducting the selection. I also took into consideration if the categories were of different sizes or if a specific document type was more common overall as I was deciding, what kind of documents I would choose. The aim was to cover as many categories and subcategories as possible, while still addressing each document type and the relative differences in incidence and importance.

These twenty documents that were selected for the heuristic evaluation represent ten different document types and two main categories. Two of the four main categories – "electrical" and "mechanical" – consisted only of image-based documents or lists, so none of their documents are represented in the heuristic evaluation. Out of the other two main categories, "general" is by far the largest, so respectively, a greater number of documents (16) was selected from it compared to the other category, as four documents were selected from "installation". "General" is also the most varied category including eight out of the ten document types, which demonstrates further why such a high number of documents were selected from it. Figure 1 illustrates the ratio of selected documents between the three main categories. Table 1 on the other hand shows how the selected documents are divided between different document types.

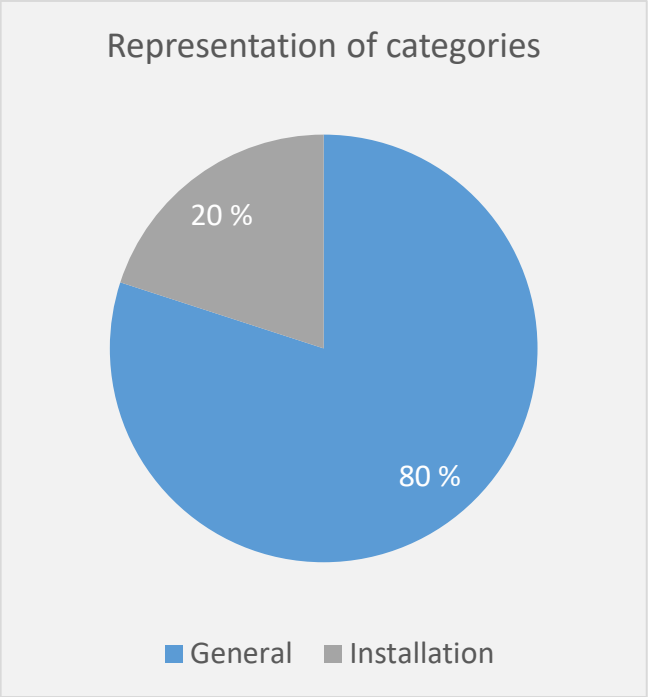

Figure 3. Document category ratio.

Table 1. Document type ratio.

Document type	Quantity
Function description	3
Instruction	3
System description	3
User manual	3
Operating instruction	2
Requirement specification	2
Technical specification	2
Installation instruction	1
Maintenance instruction	1

The final division of documents also takes into account the exploratory interviews, which is why there are altogether three different function descriptions and two documents from the subcategory "safety instructions". Function descriptions were not as numerous as, for example, instructions or system descriptions, and the two subcategories for safety instructions were quite small in relation to some other ones, but adjustments were made to match the emphasis brought up during the interviews.

After the document type and category ratio was decided, the documents were selected. This selection was done mostly at random, although some aspects were considered to guarantee maximum diversity; some documents in the documentation set were almost identical to one another, for example when multiple installations needed to be done in slightly different locations. Also, the subject of the document was further considered, so that if, for example, a technical specification regarding an interface unit was selected from "general", other subjects would be preferred over interface units when selecting documents from the other category or of different document types. As the length of documents varied from one page to almost hundred pages, I decided to analyze

only the first eight pages of each document. This also means that documents with less than eight pages were excluded from the selection. With twenty documents selected, the heuristic evaluation covers altogether 160 pages of documentation.

3.1.2 Inscription-based heuristic expert evaluation

In this study I will use heuristics created by Purho (2000), which were introduced in section 2.1, and utilize them while conducting the heuristic evaluation. Purho's heuristics were created specifically for evaluating technical documentation and they have also been utilized in practice (e.g. Rautava 2018), so they seem very suitable for my purposes. I see that using them will help me address all necessary aspects relating to technical documentation usability. However, I will use heuristic evaluation slightly differently from its normal application, because my aim is to assess if the documentation seems to be targeted at a specific user group.

Technical documents can be classified as utility texts, which means that they are read for reaching another purpose, such as solving a problem, which affects their form as well: information is provided only if it is necessary for the user for achieving their goal (Suojanen et al. 2015, 30-32). Therefore, it can be argued that readers of technical documents can be seen just as much as users as those using a physical product (Suojanen et al. 2015, 30). Seeing readers as users means that the concept of *inscription* (Akrich 2000, 208), which usually used in the context of devices and systems, can be applied to technical documents as well (Suojanen 2018, 61). Inscription means that the creator of a product – in this case the writer of a document – has several conscious and unconscious assumptions about the user, which affect the decisions the creator makes along the process and which are transferred to the final product (ibid.). This would suggest that these assumptions made by the writer could be decoded from the technical document by assessing the content. I decided to utilize the concept of inscription in this study by coupling it with heuristic evaluation and thus creating a new way to utilize usability heuristics.

As illustrated in section 2.1.2, heuristic evaluation is a valuable tool when assessing different usability aspects of a product. I reasoned that heuristics created specifically for technical documentation could be utilized as a basis for creating a systematic method for going through different aspects affected by inscription, so I decided to use Purho's (2000) heuristics in this study. Not all of his heuristics would be as likely affected by inscription, so I decided not to include two of the heuristics – "consistency" and "match between documentation and the product" – to the revised list of heuristics. Consistency is important as such for usability, but it remains important regardless of the user's real or imagined qualities. Same applies to the heuristic evaluating if the document matches the product. I see that these two heuristics are rather absolute in their evaluation: if they are fulfilled, it is good, if not, it is bad – there is no user quality that would make it reasonable to disagree with this statement. Therefore, if all kinds users would be best accommodated with exactly the same way, inscription would not affect it and, hence, it would not be of value for my analysis. The rest of the heuristics listed by Purho represent at least some form of subjectivity. For example, "the match between the product and the real world" depends on user qualities: use of specific vocabulary can be confusing for a one type of user but cause no problems for another. Hence, the choices the writer has made when choosing to use specific vocabulary can tell us something about the inscribed user. Especially when these kinds of aspects are evaluated through multiple heuristics, there might be enough information for forming an image of the inscribed user.

Based on this reasoning, I used eight out of ten heuristics by Purho and developed questions to help to apply them for my purpose. The questions are designed so that they would focus the attention to features that I assessed to be most affected by inscription. These include open-ended questions (e.g. "what kind of vocabulary is used?") but also more detailed close-ended questions (e.g. "is specialist vocabulary used?"). The detailed close-ended questions address aspects that can provide straightforward information about the inscribed user, such as expected qualities, whereas

the open-ended questions allow me to assess things that I do not know to expect. These heuristics and questions are outlined in Table 1 and explained in further detail below.

Table 2. Heuristics and questions to apply them to evaluate inscription.

	Heuristic	Questions

1	Match between documentation and the real world	• What kind of vocabulary is used?
		  ○ Is specialist vocabulary used?
		  ○ What kind of terms are explained / not explained?
		• How are technical concepts explained?
		  ○ How much in detail?
		  ○ What prior knowledge is the user expected to have?

2	Purposeful documentation	• What is the purpose of this document?
		  ○ Is the purpose stated explicitly?
		• What kind of use does this type of division of information serve?
		  ○ Does a document consist of several interrelated subjects or a single specific theme?

3	Support for different users	• Is there support for different users?
		  ○ Are there information summaries?
		• If different types of user needs are acknowledged, how is this done?
		  ○ Can the experienced user skip unnecessary information easily?

4	Effective information design	• What kind of information seems to be given most importance?
		  ○ How is it featured?
		• How is important information explained?
		  ○ How much in detail?
		  ○ What kind of language is used?
		  ○ Does this differ from the rest of the documentation?

5	Support for various methods for searching information	• What kind of methods for searching information are supported?
		  ○ How useful are e.g. table of contents, headings, or references?
		  ○ What kind of use do these search methods complement?

6	Task orientation	• What kind of tasks does the documentation support?
		  ○ E.g. installation, gaining general / special information, using it as a reference?
		• In what kind of conditions can the documentation be used?
		  ○ E.g. in office, on site, in specific task related conditions?
		• What is the level and amount of information provided?
		  ○ How does it support completing the tasks?

7	Troubleshooting	• What kind of troubleshooting information is available? • What kind of errors or problems is the user expected to encounter?
8	Help in using documentation	• What kind of help is provided for using the documentation?

I will not assess the inscription while conducting the evaluation, but rather it will be done afterwards by addressing a question: “what does this all tell us about the user?” For example, when

the first heuristic is assessed, the style of vocabulary can suggest at whom is it targeted: if specialist vocabulary is used without further explaining the terms, it can be assumed that the inscribed user should already be familiar with it. This would mean that the user is probably someone who has come accustomed using this vocabulary either via their studies or work. Same type of approach applies to all the other heuristics as well. The analysis of the different heuristics gives a slightly different point of view to the user either in relation to their expected qualities or their intentions and purposes for using documentation. I will outline below one heuristic at a time what kind of things could be deducted from the information gained from the answers to the questions in Table 2.

1. In addition to vocabulary, the way of explaining different concepts, decisions to explain certain abbreviations, and the level of detail used in explanations can tell us, what is the assumed background knowledge on the subject.

2. The content of the document illuminates the intended use. The number of separate subjects covered in a document may be one of the factors suggesting a specific purpose, so it could be used to evaluate the purpose of the inscribed user.

3. The availability of different level information can help us determine, if there are one or several inscribed users. For example, providing short summaries in addition to more detailed explanations can help an experienced user to skip unnecessary information.

4. Features emphasizing importance – e.g. giving a subject separate section or a title, or presenting information in a table or figure and hence making them stand out from other text – can help us to determine the purpose of the inscribed user.

5. Supported search methods can give us information about how the user is expected to utilize the documentation and what is their purpose. References to other sections/documents can also indicate the user's knowledge level.

6. As technical documentation is usually used to solve a specific task, suitability for different tasks or environments can tell us about the user's purpose for reading the documentation.

7. Errors covered either explicitly or implicitly in documentation shed light on the user's purpose, and the differences in importance given for recovering from specific errors can also tell which are the user's most important tasks in which they must succeed.

8. Help provided for using the documentation can give hints about the intended purpose, and the amount of help can allude to how familiar the user is expected to be with this kind of document.

There are also limitations for inscription-based heuristic evaluation. Traditional heuristic evaluation assesses how usable documentation is for the expected user, whereas when heuristic evaluation is

used to assess inscription, it may be difficult to determine if something is a sign of inscription or simply a failing in a document. For example, if abbreviations are used and some of them are left unexplained, it can mean that the inscribed user is expected to be familiar with them and that no definition or explanation is needed. However, it could also be that the writer of the document has simply forgotten to include a definition or explanation for the abbreviation, in which case it would be an error in the document and interpreting it as inscription could give false information about the expected user. However, if the results from different heuristics support one another, it is more likely that the choices were affected by the inscription; it would be unlikely that the document would include multiple errors all pointing towards the same conclusion. Therefore, if different heuristics produce completely contradictory results, it could be argued that the differences are more likely to be the result of defective documentation than inscription. Nevertheless, it must be acknowledged that it is possible that defects in documentation decrease the reliability of the results.

After conducting the heuristic evaluation, I will create short summaries which outline the inscribed user for each document. Then I will compare these summaries and observe possible patterns in differences between different document types. Finally, I will list all the different inscribed users found in the documents, so that they can later be compared to the user personas created on the basis of the interview data about real users and their qualities.

3.2 Transforming users into personas

The creation process of user personas in this study follow the steps devised by Pruit and Adlin (2006, 165-166) that were introduced earlier in chapter 2.2:

1. Identifying important user categories
2. Processing data relating to users
3. Using the processed data to create persona skeletons for different user categories
4. Prioritizing the persona skeletons
5. Developing the selected persona skeletons into fully fleshed out personas
6. Validating that the final personas still reflect the data

Methodology and results are slightly merged when the steps are performed in practice, as the knowledge of the important user groups need to be at hand before proceeding into next steps. Because the main focus of this study is on the final user personas and the information conveyed through them and the interviews, I will only address the identification of important user categories as a part of the methodology to reach the final goal.

This section is divided into three subsections. In the first subsection I will address the first step in the model by going through the process of identifying important user categories and other preliminary work relating to user personas. In the second subsection I will address the second step by describing the data itself as well as methods used to gather it. In the last subsection I will explain the methodology for the rest of the steps: how I will process the data and use it to create first the skeletons and then the final personas.

3.2.1 Identifying important user groups

Identifying important user groups was a long process. When I started working on this study, I had already worked at the company that commissioned this case study and had even talked about the ideas about possible personas with some people, so I already had initial idea of who the important user groups were. I hoped to verify this by attaining information from project management. I aimed to find out to who they were sending the documentation and which documents were sent for each user group. However, this proved to be unfitting for my purposes for several reasons. Firstly, the methods of making documentation available varied a lot, so there was no one source that could be consulted to gain all the necessary information. Secondly, it was speculated within the company if the all the users truly needed all the documentation that was sent for them. So even if there would have been a way for me to gather information about different documents sent for different user groups, it would not necessarily have told me reliable information about how important this user group actually is.

After I had realized that my initial plan would not yield useful information, I decided to change my approach. Instead of trying to find existing quantitative data about documentation and the users, simply talking to people proved to be very useful. I attended regular meetings with the two people overseeing my process, who were also in charge of documentation within the company. They helped the process by talking to personnel at the company and explaining them the main goal of my thesis and exchanging ideas about the users. I found out that the information about the users was very scattered between different departments within the company, as different people were in charge of very different aspects regarding the products and thus communicated with different types of users. This information included more details about the user groups that had already been established and helped to see the diversity of different users even within the same user group. Many of the people that were consulted on their information regarding the users also helped with getting in contact with the users so that they could be interviewed, so their knowledge and contacts were helpful in multiple phases during this study.

Eventually I evaluated all the information gained from different people and narrowed the most important user groups down to five groups. These are:

- Suppliers
- Manufacturers
- Product testers
- Commissioning and maintenance personnel
- End users

Suppliers include companies that deliver smaller parts for the final product, manufacturers are responsible for building the product, product testers conduct different types of tests to make sure that everything works accordingly, and personnel in charge of commissioning set the final product to use after the manufacturing has been completed. After the commissioning, the end users start to use the product and whenever necessary, maintenance is conducted. I found out that usually the same personnel conduct both the commissioning and the maintenance, so they are combined under

one user group. All these user groups use technical documentation to succeed in their interaction with the product and all of them would be expected to have slightly different needs for it.

These user groups were surprisingly similar to my first sketches of them, although some changes were made as I learned more about different users. Different kinds of practical reasons slightly affected both the number of interviewees as well as the final list of user groups, as I did not see it reasonable to include user groups that could not be interviewed. However, as I stated earlier, even the selected user groups consist of sometimes vastly different types users, so every single type of user could not have been covered in this study. Having more variety and including more user groups from multiple departments, companies, and countries would have been interesting and it may have revealed qualities that are not present in the data I collected, but the user groups that were selected to be interviewed already produced valuable information regarding the users.

3.2.2 Interviewing the users

Interviews in this study were semi-structured and they were conducted either in person or via online telecommunication application. Semi-structured interview is typically used when there is some prior knowledge regarding the subject but not enough detailed information (Wilson 2014, 24), so it was clearly the best option for the interviews. There was a general idea of how the documentation was used and what kind of problems were usually reported but there was no detailed understanding on what kind of real-life situations and environments the different user groups use the documentation or how do they use it. Semi-structured interview allows the interviewer to gather systematic information regarding important topics while also addressing new issues that emerge during the interview (ibid.). Usually it is divided into topics or themes which all have some preplanned questions (ibid.) as was in this study as well. Each interview in this study consisted of 16 preplanned questions (see Appendix A) that were divided into four themes: background information, general questions regarding the use of documentation, questions regarding the usability of the company's documentation, and finishing questions that allowed the interviewees to bring up

something that had not yet been covered. 13 interviews were conducted altogether, ten of which in Finnish and three in English. Most questions were somewhat open-ended, and if necessary, further related questions would be asked. For example, when I asked if the user read the entire document, simply scanned it through, read specific sections, or searched for specific information, follow-up questions included asking about ways of finding information and whether they used table of contents, and so on. Also, if an interviewee brought up an interesting theme or commented something unexpected, I asked further questions.

The interviewees were asked to fill a background information form (see Appendix B) that consisted of simple questions relating to their age, gender, and occupation. Information regarding age and gender would help me to assess the most likely demographic of the user groups and therefore it would be useful when adding personalizing information to the personas. Occupation also provided some information about the type of user within the user group, which would help me to understand better the reasoning for possibly different goals within the same user groups. I asked for permission for the interview and the use of their answers by either asking them to sign an agreement stating the conditions, or to reply to an email and state that they had read the conditions and agreed to them.

After the first interview, I modified the question list by moving one item from the background information form into the final question list. This question was related to educational background. At first, I simply had a multiple-choice question in the background information form in which the interviewees needed to specify the level of education they had completed and select the type of institution it was from. This was motivated by my goal to find out, if the interviewee was an engineer or had education very similar to it. I know that much of the documentation in the company is produced by engineers and that non-engineers have sometimes reported problems in understanding it, so I wanted to evaluate whether it was an aspect that created problems for great number of users. I had trouble designing the form of this question so that it would tell me what I

wanted to know without communicating any attitude or expectation. Eventually at the first interview, after receiving the background information form, I decided to start the interview by asking about the interviewee's educational background to gather more detailed information. This became the new starting question for the rest of the interviews, and the multiple-choice question relating to education was removed from the background information form altogether. I was prepared to make further changes to the questions, but the first interview indicated that the rest of the questions worked in fact very well as they were, so no other changes were necessary.

Although my questions were planned to cover different aspects of the use of documentation quite thoroughly, I made an effort to encourage conversational atmosphere so that the interviewees would feel comfortable providing as much information about the documentation as possible – even if it would not directly relate to any of the questions. This would allow users to bring up topics or themes that I had overlooked or had not covered properly. To maintain this conversational atmosphere I would sometimes change the order of the questions if the interviewee brought up something that related directly to another question in my list. I think this may have been beneficial, as some of the interviewees brought up examples or subjects that I would not have been able to cover with preplanned questions, such as data relating to some working environments or habitual routines that were specific to a certain company or even to a certain department.

The five different user groups identified in section 3.2.1 were represented in the interviews: out of the 13 people that were interviewed, three were suppliers, five represented manufacturers, two used documentation to conduct product testing, two oversaw product commissioning and maintenance, and one was a user of the final product. This information is illustrated in Figure 3.

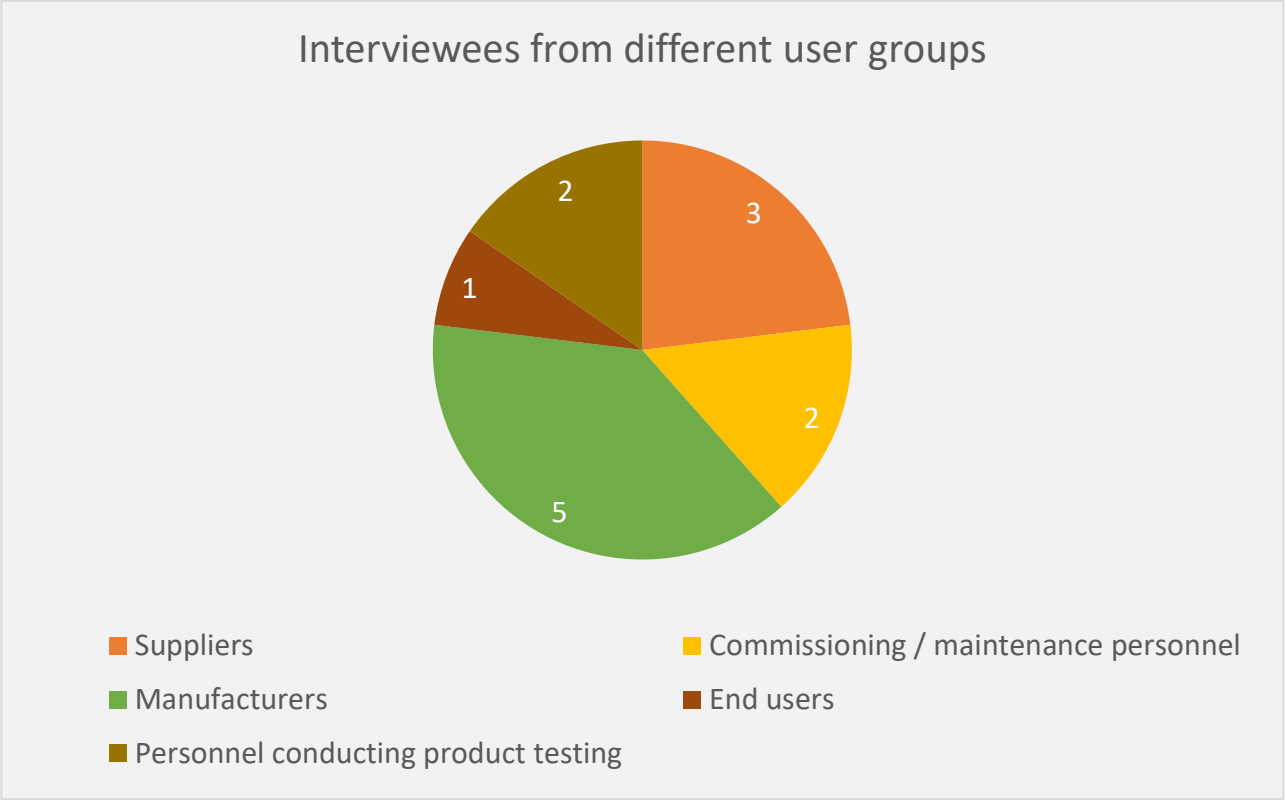

Figure 3. Different user groups represented in the interviews.

Finding potential interviewees required inter-departmental cooperation within the company and it was conducted simultaneously with the identification of the important user groups. Different departments communicate with different user groups, so employees that had existing relationships with specific user group representatives were contacted and the idea of this study was introduced to them. They then recruited candidates for the interview. However, not many users are in direct contact with the commissioning company, so once we had established communication with someone interested in taking part in the interview, we inquired if they knew someone else that could participate. This process was somewhat unpredictable, as it involved multiple people that often had very different ideas regarding different user groups and those that should or should not be interviewed. However, the process also helped me gain further knowledge about different types users that had not surfaced previously, which – as mentioned earlier – helped the identification of different user groups.

Most of the interviews were individual interviews, but due to sudden changes in circumstances, one interview was conducted as a pair interview. Also, in addition to myself, the person in charge of documentation was present in ten interviews. She mostly observed and sometimes asked supplemental questions, so I conducted most of the interview myself in regards of both preplanned and follow-up questions.

The interviews were conducted during spring 2020. The length of the interviews was on average 40 minutes, with the shortest interview lasting about 18 minutes and the longest interview lasting 1 hour and 6 minutes. The pair interview is not part of this calculation due to its special nature. I made notes during the interviews, but they were also recorded so that I could later verify something if necessary. One of the individual interviews was not recorded, because for some reason I simply forgot to start the recording. However, the notes I made during the interview were rather comprehensive, so I decided to include the interview in this study nevertheless, as the interviewee was one of the few people from abroad that I managed to interview. I did not transcribe any of the recordings, as it would not have yielded much extra benefits.

3.2.3 Creating the personas

Identifying the important user groups and gathering data about these users needed to be finished before I could start creating the personas, and also a detailed plan for utilizing all the data needed to be designed, which is what I will cover in this subchapter. As illustrated in the beginning of the section 3.2, the creation of user personas consists of first creating simplified skeletons for each user group persona by observing several different aspects in the interviewees' answers and later transforming them into fully fleshed personas by adding personal details. Goals, behaviors, and attitudes are often considered as the most defining aspects regarding personas (Mulder and Yaar 2006, n.p.), so I decided to focus on them while outlining the skeletons. Not all the qualities I chose from the interviews are directly linked to these three aspects, but I see that they all affect at least

one of them. My goal is to use the list to compress the vast interview data into a simple summary of the most informative qualities of each interviewee. These qualities consist of:

- User's main goals
- Examples of practical goals
- Examples of practical problems
- Educational background
- Experience in the position
- The importance of documentation in their work
- Choice to use only electronic, only printed, or both versions

The user's main goal describes the end-result of their part in the product lifecycle. For example, for manufacturers it would be completing the order and getting the product manufactured. In contrast, the examples of practical goals include smaller goals that users come across on a daily basis. Practical problems exemplify the users' practical goals by illustrating what kind of things can impede them from achieving these goals. All of these are directly linked to the users' goals.

The four other qualities – educational background, experience in their current position, importance of technical documentation in their work, and the way in which they choose to access the documentation – relate to or affect their behaviors and attitudes. Educational background as well as their experience in their current position will also be an indicator on how familiar they are both with the field and this type of documentation, which will most likely affect their behavior when they use the documentation and what kind of attitudes they have towards it. Same applies to the importance of documentation in their work: people who use documentation regularly will most likely have different behavior and attitude towards it than those who rarely deal with documentation. Finally, the choice to use only electronic or printed version, or using them both also illuminates the users' attitudes and behavior. For example, if a user only uses the printed documentation, it directly affects the way they can use it, in contrast to those that use the electronic version.

Several users were interviewed from the user groups defined in section 3.2.1 and they brought up different aspects about using documentation. The short summaries of each interviewee

consisting of the qualities mentioned above will be viewed in relation to other interviewees within the same user group. Then I will compare it to the results of the different user groups to see, what seem to be the biggest differences between them. It might also be that there are similarities between some or even all different user groups, in which case it can be concluded that these aspects should not be emphasized as being characteristic of a specific group of users. For example, if all users prefer to use the printed version of the documentation, it needs to be emphasized differently in contrast to possible situations where only one group of users prefer the printed documentation for a specific practical reason. So, not only the direct answers matter but also the reasons the users give for their choices.

In addition to the defining aspects, personas also include personal information that makes them feel real, even though it might not be relevant for the user's main goals. This information consists of name, age, gender, and sometimes other things such as a motto, hobbies, marital status, or personal goals (Mulder and Yaar 2006, n.p.fuse). I will include some personalizing features such as a name, a photo, location and family information, but otherwise I will illustrate their personalities through work related factors, as it will allow me to ensure that the persona information is concise but at the same time provides enough details to make them different. Also, a photo and a scenario are often included in the persona. Scenarios are detailed descriptions on how the user interacts with the product (ibid.), which help to illustrate the users' goals, behaviors, and attitudes in practice. I will include both a photo and a scenario for each persona. This personalizing information will be added to the personas when the persona skeletons have been completed and prioritized, and the final personas are being fleshed out.

The personas are not developed simply by creating an average person based on the interviewees' answers, as that would not cover the diversity between interviewees. Also, if only one person is interviewed within a user group (as was with end users), the persona cannot be made identical to the real person either, as their anonymity must be protected. Therefore, I will make

small changes to create a fully developed persona that has all the relevant goals, behaviors, and attitudes that came up during the interviews but that is not an identical copy of any real person. Also, as I only interviewed 13 people, they are not likely to represent all possible users. For example, all interviewees in this study were males and although that might indicate that there are more men working in this field than women, I do not think that their gender defines them in their work. Making a female persona would therefore be completely reasonable, as there most certainly are also women that use the documentation even if their number would be significantly lower than the number of men. This would also work as a reminder that even if the average user would be, for example, a white male with an engineering background, other types of users also exist. Of course, when making changes like this, I will need to evaluate, what is relevant for the user and defines some of their goals, behaviors, or attitudes, and what on the other hand can be changed to create a more diverse set of personas.

Finally, the fully developed personas are validated by assessing them in comparison to the data to make sure that each persona still reflects the data that was used as a basis in their creation. As mentioned earlier, I summarized each interviewee in regard to their goals, behaviors, and attitudes. The validation of personas will be conducted by comparing the final personas to these summaries. Also, if necessary, I will go back to the recordings to check that the personas do not contradict anything the real users said during the interviews. If something is contradicting, I will make changes to the personas, but if not, the personas will be completed.

3.3 Comparative analysis

The last part of the study is the comparative analysis during which I will compare the results from the heuristic evaluation to the user personas. This means that the characteristics of the inscribed user or users that surface during the heuristic evaluation will be compared to the qualities of the personas and I will evaluate, how well the documentation suits each persona. During the interviews all interviewees were asked which documentation types they normally use, so even if there are

differences between the inscribed users in different document types, I will nevertheless know which document types are relevant for each persona.

The two methods are normally used in very different situations, so they may produce rather different types of results, which can make it difficult to compare the inscribed users and the personas. As I outlined in section 3.1.2, the evaluation focuses on the use of vocabulary, tasks, and purposes on a rather broad level, whereas personas go more into detail in how a specific user might use the documentation in their everyday tasks. However, it should still be possible to see if the persona's goals, behaviors, and attitudes are in conflict with the characteristics of the inscribed users. I will also evaluate, if some user groups seem to match better with the inscribed users than others or if specific documentation types appear to be more problematic than others.

I will conclude the comparative analysis by estimating the overall match between the two sets of results and also the type of information gained with the two different methods. If the results are neither a match nor contradict each other, it may be that they simply produce different types of information about the same users. This would be interesting for envisioning how they could be most efficiently used to complement each other to provide an optimal setting for producing usable documentation. It is possible that other benefits could also be achieved so I will observe other possible uses for the information that can be gained with these two methods.

4 Analysis

In this chapter, I will first go through the results found during the heuristic evaluation. Secondly, I will outline what kind of personas I created during the persona phase. Lastly, I will analyze both results through comparative analysis.

4.1 Results from the inscription-based heuristic expert evaluation

I started the heuristic expert evaluation by first reading all documentation used in this study. I used the questions listed in section 3.1.2 to write down notes while assessing the documents one at a time. There were not always simple answers to all the questions, but they helped me to direct my attention to different aspects in documentation. If I was unsure how to answer a question or if I noticed something that could affect the results, I addressed it in my notes. I noted down structural features in documents, such as bullet lists, numbered lists, tables, figures, and fillable sections, and cited examples of interesting features. In addition, always when I noticed something that might tell something about the users, I noted it down. After analyzing each document, I also wrote a short summary of what was my overall impression about the inscribed user.

With some documents the heuristic evaluation helped me to get a very clear idea of what kind of person the inscribed user is, while with others it was not clear at all: sometimes the results gained with different heuristics and specifying questions were in agreement with one another but sometimes they were conflicting. However, after finishing the heuristic evaluation, I noticed that many notes relating to clear observations about inscribed users were related to similar features in many different documents. The observations made on the basis of different heuristics and different specifying questions provided also notably different types of information about the user: some observations related to the presupposed knowledge and some were more relevant to their purposes of using documentation. Therefore, simply stating that the inscribed user is – for example – a specialist did not acknowledge the full variety within different specialist users.

Based on these observations I divided the results into three different themes:

- Information relating to user's knowledge level
- Information relating to user's purposes with the documentation
- Information relating to supporting different types of users simultaneously

As I mentioned, the information relating to the inscribed user was not clear in all documents, so I decided to group my observations thematically to see, what kind of knowledge level and purposes each of the document supported. I will describe the results regarding each theme in subsections below, explain which heuristics and specifying questions led me to the conclusions I made and provide examples from the documents.

Many of the heuristics and questions relating to them were related to multiple things. For example, choices regarding vocabulary can tell us a lot; if the user is expected to know certain specialist terms, they might be expected to be an expert, or if the vocabulary includes terms with high information value, it might suggest a need for very detailed understanding and therefore possibly a practical application or referential use, or if the documentation uses specialist terms but explicitly explains them as well, different users might be accommodated.

However, although some patterns can be detected when individual documents are compared, each of the documents is still unique and its document type and subject inevitably create different emphasis and thus affect the observed features. This means that many things can affect the observed qualities, so the results can only operate on the level of likelihoods. Therefore, although I use tables and list features that would in my opinion support a specific interpretation of an inscribed user, I will also consider my own estimation on the overall analysis of a document.

4.1.1 Knowledge level of the inscribed users

The first theme to be addressed relates to the knowledge level that the user is expected to have. In this study, the knowledge level was most clearly linked with expertise in the field and there seemed

to be vast differences between documents regarding this. Following heuristics and specifying questions were especially helpful in evaluating this theme:

- 1st heuristic – match between documentation and the real world:
  - Is specialist vocabulary used?
  - What kind of terms are explained / not explained?
  - How is technical information explained?
  - What prior knowledge is the user expected to have?

- 4th heuristic – effective information design:
  - How is important information explained?

- 6th heuristic – task orientation:
  - What is the level and amount of information provided?

As can be seen, some of the questions are likely to be interrelated at least to some extent, and indeed, while conducting the heuristic evaluation, I noticed that same observations were related to multiple questions. However, three main features seemed to yield the clearest information regarding the qualities of the inscribed user. These were: use of abbreviations, use of specialist vocabulary, and the way the important information was communicated to the user. The use of abbreviations relates to the first two questions under the first heuristic, as abbreviations are still part of vocabulary and certain field-specific abbreviations would fall under specialist vocabulary. Explanation to some of them were provided but for some abbreviations there was no clarifying information regarding their possible meaning; this is related to the second question. The use of specialist vocabulary – in addition to abbreviations – also relates to the first two questions under the first heuristic. The last feature – the way in which important information is communicated to the user – relates to the rest of the questions. It mostly regarded observations on how specific types of information were explained, in how much detail, and what kind of prior knowledge these kinds of explanations required.

Almost all documents used abbreviations and majority of them (15) also included a table for their definitions. However, not all abbreviations were always included in the table or otherwise explained in the document. The lack of explicit explanation for an abbreviation suggests that it is

considered to be commonly known by the users and providing a definition is not necessary. Below are some examples of the abbreviations that were not explained:

- HF ("high frequency")
- TCP ("transmission control protocol")
- P&ID ("piping and instrumentation diagram")
- UDC (unknown)

Clearly there is a difference regarding the level of difficulty between these concepts: most people have heard of *high frequency*, whereas *UDC* proved to be so special that even having the entire document available, as well as the company's abbreviation list, I was unable to find out, what it means. It was referred to as a type of terminal and it was placed in a figure that illustrated an electrical network, so when acknowledging this context, it seems to imply strongly that the inscribed user has prior knowledge in the field. However, even using HF instead of writing out "high frequency" would seem to suggest that the inscribed user must either be familiar with it or be able to deduce its meaning via contextual clues. This could be a sign that the user is expected – at minimum – to be somewhat familiar with the subject.

The second feature – use of specialist vocabulary – refers to words that are usually reserved for specialized human activities, such as different sciences or institutions (Roelcke 2018, 489). According to the rules of technical communication, different types of vocabulary should be applied to different types of users to create a usable document (Cleary and Slattery 2018, 315). So, if this kind of vocabulary is used without providing clarifying explanations, it can be assumed that the user needs to be already familiar with it. However, even if this kind of specialist terminology is explained, it would be laborious to read if the user had no experience with it and would have to learn, understand, and remember a high number of new terms. The specialist terms that were not further explained in documentation included items from multiple different fields. Below I have listed some specialist fields accompanied with examples I found during the heuristic evaluation:

- Computing: Boolean, analog

- Mechanical hardware: solenoid valve, connection ferrule, flange
- Physics: kinematic viscosity, Reynolds number, cm^3/r

None of these were explained in text, neither were they included in the table explaining terms and abbreviations, so even though it is possible for the user to check the meanings from an external source, it does not seem believable that it would be the intent of the document. Rather, for example in the second example, the inscribed user is not only expected to know that the words refer to different kinds of mechanical hardware parts but also be able to understand what they look like and how they are used. There were also differences between documents in regard to how much specialist vocabulary was used and whether they explained some of these terms. This would support the interpretation that choices relating to vocabulary are being adapted to different types of users.

The third feature was the way the important information was communicated to the user. If a document includes, for example, a technical subject, the level of detail and vocabulary used in its explanation can allude to the overall prior knowledge the user is expected to have. This is closely related to the two previous features, but it takes one step further; it considers multiple different factors that constitute to communicating information. While the prior two features can give us valuable clues about the expected knowledge level, the overall way of communicating information also plays a crucial part in either making it easier or more difficult for the user to understand the document. I also paid attention to the level of detail when documentation provided step-by-step instructions. It is telling whether the instruction includes information on *how* to do something or if simply an outcome is mentioned. This can also be seen in general explanations, as the user can be expected to infer that simply the existence of a feature or a part means that some supplemental benefit is achieved, or it can be explicitly explained. Following examples show ways of presenting information in a way that does not require extensive prior knowledge to be understood. The main information is bolded and the unbolded section provides extra details.

- **Lock the bushing** with the M20 nut (Figure 4, part 2) of the tool. Use a 30 mm wrench. Use tightening torque of 200 Nm. Hold the bushing in place with a 36 mm wrench.

- **Full-redundant cooling fans are delivered for extra redundancy requirement.** In this option, only one fan runs at a time. One fan provides sufficient cooling air flow. The back-up fan starts if the first fan motor fails.

The vocabulary is either very general or specialist terms are explained in a way that would clarify their meaning. In the first example it can be argued though that some kind of prior knowledge in the field is required, but the example provides nevertheless very detailed description of something that could simply be summed up with: “Lock the bushing.” The second example on the other hand consists of descriptive information, but even there extra explanatory information is provided regarding the engineering-specific use of the word *redundancy*. Usually whenever this meaning of the word *redundancy* was present in the documents of this study, it was not explained nor was it specified what it meant for the particular product. However, in this example, it is stated explicitly, how full-redundant cooling fans operate. This allows the concept to be understood even by users who are not familiar with engineering vocabulary or technical aspects of the product.

Following examples show another way of providing information in similar situations. On these occasions prior knowledge is required:

- Fastening must be done so that the thermal expansion of pipes is possible, and vibration is prevented.

- - - the cabinets are fully redundant.

The information in these two examples is much denser and although it outlines the main messages and tasks, to gain a full understanding of the situation the user must complement this information with their prior knowledge. In the first example the user needs know how to fasten the pipes so that the conditions are met. In the second example the user is at minimum expected to know the engineering-specific meaning of *redundancy* and understand the main purpose behind it.

Table 3 features all of the three features and lists, if they were found in the document. If a document meets all three conditions, it is marked with green color to indicate high likelihood for required expertise. If two of the three conditions are met, I consider the likelihood to be medium and it is colored with yellow. If fewer conditions are met, the likelihood is considered to be low, and those rows are left white.

Table 3. Items suggesting that the inscribed user is a specialist. X indicates that the condition is met.

Document	Not all abbreviations explained	Text includes specialist vocabulary	Prior knowledge on certain concepts required
Function description 1	X	X	–
Function description 2	X	X	X
Function description 3	–	X	X
Installation instruction	X	X	X
Instruction 1	–	–	–
Instruction 2	–	X	X
Instruction 3	–	–	X
Maintenance instruction	X	X	–
Operating instruction 1	–	X	–
Operating instruction 2	X	X	–
Requirement specification 1	X	X	X
Requirement specification 2	X	–	–
System description 1	–	X	X
System description 2	–	X	X
System description 3	–	–	–
Technical specification 1	X	–	–
Technical specification 2	–	X	X
User manual 1	X	X	X
User manual 2	–	–	–
User manual 3	–	X	–

Overall, out of 20 documents in 12 of them was moderate or high likelihood that expertise in the field is required. Despite some individual exceptions the table appeared to correspond rather well with the summaries I wrote during the heuristic evaluation that state the overall impression relating

to the user. I think some inconsistencies are due to the subject of the document: *Maintenance instruction* and *Operating instruction 1* both related to exceptional circumstances, and this might mean that more explanations need to be provided even if the user is expected to be an expert. Clearly, specialist vocabulary must be used to convey precise information, but the circumstances could cause problems even for more experienced users, so extra attention was seemed to be paid when giving instructions and providing information. It could also be that in these kinds of special circumstances even someone who is not an expert might have to do the maintenance.

4.1.2 Purposes of the inscribed users

There are different possible purposes for technical documentation, depending on the documentation type, subject, as well as other factors. The heuristics and specifying questions that proved to be most useful determining the purposes of the inscribed user were:

- 2nd heuristic – purposeful documentation:
  - Is the purpose stated explicitly?
  - Does the document consist of several interrelated subjects or a single specific theme?

- 4th heuristic – effective information design:
  - What kind of information seems to be given most importance?
  - How is important information featured?

- 6th heuristic – task orientation:
  - What kind of tasks does the documentation support?
  - What is the level and amount of information provided?

- 7th heuristic – troubleshooting:
  - What kind of troubleshooting information is available?
  - What kind of errors or problems the user is expected to encounter?

Some specifying questions are explicitly related to purpose: first questions under 2nd and 6th heuristic are examples of this. Other questions relate to aspects that can be used to differentiate between different purposes. While conducting the heuristic evaluation, three main purposes surfaced: practical application, referential use, and learning purpose.

Practical application refers to situations where the goal of the inscribed user is to use the documentation to succeed in a specific task (Kmiec and Longo 2017, n.p.). For example, detailed step-by-step instructions suggest that inscribed user may not only read the information but also apply it in practice. Referential use means that the documentation includes detailed information usually organized alphabetically by menu item or in other logical order so that the user can easily access it effortlessly (Jayaprakash 2008, 76). For example, some documents include tables that list precise values, mechanical parts, measurements, and so on, which work well as a reference but would not be an ideal for other purposes. Learning purpose is the most general one of the three purposes. It suggests that the documentation is simply there to teach the inscribed user something about the product. For example, general language with few precise numerical values and perhaps a wider range of subjects would be beneficial when the aim is to give the user a basic understanding of the product or part of a product.

With the help of the specifying questions, I was able to find five features that seemed to be linked with **practical application**: explicit recommendation to use the document when working, presence of numbered step lists relating to procedures, expected errors that related to practical tasks, inclusion of fillable sections, and extensive amount of highly detailed information. As I only needed to note if the document was recommended to be used when working, it did not require any interpretation, unlike the other features.

Although procedural information can be provided in a paragraph like any other information, it is very typical that the procedures are divided into separate steps that are usually in numbered order (Kmiec and Longo 2017, n.p.). However, numbered lists can be used for different purposes, such as listing system subparts, so I assessed whether the numbered step lists were directly related to procedures. Only then I considered them to be a sign of practical application.

Most of the documents (15 out of 20) included notes and/or warnings that were accompanied with a special icon that made them stand out from the surrounding text. The information in them

often drew attention to possible misunderstandings or errors, so they provided useful information when trying to evaluate what kind of errors the users were expected to encounter. Following example illustrates an expected error relating to practical application:

- Hold on to the remote control of the shaft line turning device firmly. If the remote control is dropped, the shaft line turning device may accidentally start to rotate the shaft line.

The expected error in this example is “dropping the remote”, which relates to a practical task. Other types of expected errors that did not support practical application were often linked with remembering and understanding something important, rather than with physical activity. Following example presents a notice in which the expected error relates to mental processes, which clearly supports learning purpose rather than practical application:

- Project-specific working order may change the timing of the interconnecting piping and cabling work.

Some documents also included fillable sections. These sections support an interpretation that the inscribed user would have a printed version of the document at hand during their task as the fields could not be filled electronically. Many of the fillable sections were checklists that related to preparing for or carrying out procedures, which would very clearly suggest practical application.

Finally, I observed the level of detail in documentation. This feature is common for both practical application and referential use. Here detailed information is defined as information that provides so detailed information that it seems to serve purpose as such and not support learning purpose. Following example illustrates this kind of highly detailed information:

- - - the cable shielding should be covered with a conductive tape. The tape must cover the whole surface of the shielding, including the pigtail (see Figure 5), and should be tightly pressed with fingers after every single turn.

The level of detail is excessive to support learning and it is also clearly related to practical activity.

Table 4 lists whether the five features suggesting practical application are present in each document. If a document met at least four of the five conditions, the likelihood of practical applicability is considered to be high, which is indicated with green color. Yellow color indicates a moderate likelihood with two or three conditions met, and low likelihood – less than two conditions met – is signaled with white rows.

Table 4. Items suggesting practical application. X indicates that the condition is met.

Document	To be used when working	Includes step lists	Expected errors relate to practical tasks	Includes fillable sections	Includes a lot of detailed information
Function description 1	–	–	–	–	–
Function description 2	–	–	–	–	–
Function description 3	–	–	–	–	X
Installation instruction	X	X	X	X	X
Instruction 1	X	X	–	X	X
Instruction 2	–	X	X	X	–
Instruction 3	–	–	–	X	X
Maintenance instruction	X	X	X	X	X
Operating instruction 1	X	X	–	X	X
Operating instruction 2	–	X	–	–	X
Requirement specification 1	–	–	X	–	X
Requirement specification 2	–	–	–	X	–
System description 1	–	–	–	–	–
System description 2	–	–	–	–	–
System description 3	–	–	–	–	–
Technical specification 1	–	–	–	–	X
Technical specification 2	–	X	X	–	X
User manual 1	–	X	–	X	X
User manual 2	X	–	–	X	–
User manual 3	–	–	–	–	–

Out of 20 documents 11 had moderate or high likelihood in supporting practical application. As could be expected, these documents are often associated with instructive documentation types. However, there are some notable exceptions. *User manual 3* does not seem to possess any of the

five qualities suggesting practical application, even though the documentation type would cause you to expect otherwise. This nevertheless corresponds exactly with my observations during the heuristic evaluation: even though it is listed as a user manual, its information is very general, it is not instructive and even the images used in the document are explicitly stated to be illustrative only and not necessarily matching with the final product. Also, out of the non-instructive documentation types *Technical specification 2* met surprisingly many of the conditions relating to practical application and this was also supported by the summary. It would therefore seem that items in Table 2 predict very well whether the purpose of the inscribed user is to apply the information in practice.

Although **referential use** has some similarities with practical application, there are also several features that distinguish them. As mentioned above, detailed information is common in both practical application and referential use. However, unlike with practical application, detailed information that supported referential purpose was often placed in tables. For example, one of the documents included a table that listed different sensors and technical details relating to them. It would be unlikely that someone would need to read them all at once and apply their information in practice. Their information was so precise that it would be impossible to remember it, so it did not fit learning purpose either. However, it serves referential use perfectly: when specific information regarding a specific sensor is needed, the table can be easily consulted. Also, step lists are characteristic for practical application, whereas their absence would indicate other main purpose. The absence of step lists is therefore included as a feature supporting both referential use and learning purpose.

Table 5 illuminates, whether the features suggesting referential purpose were found in each document. Documents that met all three conditions are marked with green color to signal high likelihood for referential purpose, two conditions met equals to moderate likelihood, and fewer suggest low likelihood, which is signaled with white color.

Table 5. Items suggesting referential purpose. X indicates that the condition is met.

Document	Includes a lot of detailed information	Detailed information that does not relate to procedures	Does not include step lists
Function description 1	–	–	X
Function description 2	–	–	X
Function description 3	X	X	X
Installation instruction	X	–	–
Instruction 1	X	–	–
Instruction 2	–	–	–
Instruction 3	X	X	X
Maintenance instruction	X	–	–
Operating instruction 1	X	–	–
Operating instruction 2	X	X	–
Requirement specification 1	X	X	X
Requirement specification 2	–	–	X
System description 1	–	–	X
System description 2	–	–	X
System description 3	–	–	X
Technical specification 1	X	X	X
Technical specification 2	X	X	–
User manual 1	X	X	–
User manual 2	–	X	X
User manual 3	–	–	X

Out of 20 document 8 seemed to have moderate or high likelihood for supporting referential use. As can be seen, document types relating to specifications were likely to score either moderate or high likelihood of supporting referential purpose. However, one of the instructive documents – *Instruction 3* – met all the conditions for suggesting referential purpose instead of practical application. It is difficult to say why this is; it could be that the document serves multiple purposes, or that it is simply not constructed well, or that I fail to recognize a feature that would further illuminate its purpose as my general observations did not make the matter any clearer.

Learning is the last of the three purposes in this analysis. Features that seemed to hint for a learning purpose were mostly the lack of features associated with the other two. Whereas purpose relating to either practical application or referential use would be connected with highly detailed information, document consisting of mainly general information seemed to be linked with learning purpose. This would be logical, as highly detailed information would be difficult to remember, which would not support learning very well. Following example illuminates what kind of language is considered to be general:

- The main navigation menu contains buttons for selecting a page. Each page has at least one sub-page. If the page only has one sub-page, the sub-navigation menu may not be visible.

Not only does it explain just the main concepts, but the last sentence also suggests that something *may* happen. This clearly cannot be appropriate for practical application or referential use. However, if the goal is to provide the user with overall understanding of the system, this would be quite alright. Of course it is somewhat unlikely that all the text in a document would be as vague and completely without details, which is why I evaluated each document as a whole and then estimated, whether it in my opinion could be categorized as consisting of mainly general information or whether it included a lot of detailed information.

Another feature relating to learning purpose was the number of separate subjects within a single document. 12 out of 20 documents had only one discrete subject. The rest had either two or more. Usually even the separate subjects were rather closely related to one another; they could be either sub-parts of the system, or contiguous phases within the project. They were nevertheless not so closely connected that they would be relevant simultaneously – other than on theoretical level. Having multiple separate subjects would be impractical especially if the purpose was to apply information in practice: in these situations, excess information might hinder performing in the task if the user would need to scan through extensive amount of irrelevant information.

Table 6 lists the presence of these features in a document. Again, green indicates high likelihood with all conditions met, yellow moderate likelihood with two met conditions, and rows left blank indicate low likelihood with fewer conditions met.

Table 6. Features suggesting learning purpose. X indicates that the condition is met.

Document	Consists of mainly general information	Includes multiple separate subjects	Does not include step lists
Function description 1	X	X	X
Function description 2	X	X	X
Function description 3	–	X	X
Installation instruction	–	X	–
Instruction 1	–	–	–
Instruction 2	X	–	–
Instruction 3	–	–	X
Maintenance instruction	–	–	–
Operating instruction 1	–	–	–
Operating instruction 2	–	–	–
Requirement specification 1	–	–	X
Requirement specification 2	X	X	X
System description 1	X	X	X
System description 2	X	–	X
System description 3	X	–	X
Technical specification 1	–	–	X
Technical specification 2	–	X	–
User manual 1	–	X	–
User manual 2	X	–	X
User manual 3	X	–	X

Out of 20 documents 9 scored moderate or high likelihood of supporting learning purpose. Not surprisingly, the descriptive document types (function description and system description) had more features relating to learning purpose than many of the other document types. *Requirement specification 2*, however, seems to possess all of the listed qualities relating to learning purpose. This is also supported by the summary written during heuristic evaluation.

4.1.3 Support for different knowledge levels and purposes

On the basis of the prior division, different types of support are viewed in relation to the user's level of expertise and their purpose to assess, if a document is usable for different types of users. Support in regard to different purposes carries over from the results introduced in section 4.1.2. However, as my evaluation on knowledge levels in section 4.1.1 only focused on identifying if prior knowledge is required, I need to conduct further evaluation to discover, if the documents provide any kind of support for different knowledge levels. Following heuristics and specifying questions were used to analyze the support for multiple knowledge levels:

- 3rd heuristic – support for different users:
  - Is there support for different users?
  - Can experienced user skip unnecessary information easily?
- 4th heuristic – effective information design:
  - How is important information explained?
- 8th heuristic – what kind of help is provided for using the documentation?

The first specifying question under third heuristic is very general and mainly helped with the writing of the summary, but the other questions were useful in detecting features that would support multiple knowledge levels. These two features are: same information is explained in a way that it serves multiple knowledge levels and there is guidance for finding further information in relation to a specific part that is not explained in detail.

The first feature was usually manifested by providing more precise information in parenthesis, as can be seen in following examples:

- Atmospheric hazard caused by hydrogen sulfide (H_2S) forming inside the interspace.
- - - avoid applying large angles (~180).

In these examples the overall language is rather general and does not seem to require expertise on the subject. However, the information in the parenthesis is either more specific, like in the second

example, or relates to specialist knowledge, as in the first example. The second feature was more difficult to classify.

Multiple documents also provided guidance for finding further information in relation to a specific part that was not explained in detail within the document itself. This guidance usually manifested as references to other documents. However, not all references to other documents acted as guidance for further information, so I had to evaluate, whether these references could be interpreted as way of supporting users with different levels of knowledge. The example below illustrates what kind of references to other documents were seen relevant in this context:

- - - and lock with thread-locking compound ([reference for another document])

This information was located within a procedural step list and although the reference to another document probably includes further details relating to the step, the crucial information regarding the procedure is already provided in the text ("lock with thread-locking compound"), so it would be probable that a specialist would not need to consult another document to proceed.

Table 7 illustrates whether a document seemed to support either multiple purposes or multiple knowledge levels. The table has been divided into two parts accordingly. The rows on each part are colored separately, so green color means in this instance that the document meets all the conditions for its section (either supporting multiple purposes or different knowledge levels), yellow means that the document meets at least half of the conditions, and white color indicates that the document meets less than half of the conditions.

Table 7. Different types of support for different types of users. X means that the condition is met.

Document	**Support for different purposes**			**Support for different knowledge levels**	
	Practical application supported	Referential use supported	Learning purpose supported	Multiple level explanations for same information	Guidance for finding further information
Function description 1	–	–	X	–	–
Function description 2	–	–	X	–	X
Function description 3	–	X	X	–	–
Installation instruction	X	–	–	–	X
Instruction 1	X	–	–	–	X
Instruction 2	X	–	–	X	X
Instruction 3	X	X	–	–	–
Maintenance instruction	X	–	–	–	X
Operating instruction 1	X	–	–	X	–
Operating instruction 2	X	X	–	–	–
Requirement specification 1	X	X	–	–	X
Requirement specification 2	–	–	X	–	–
System description 1	–	–	X	–	–
System description 2	–	–	X	–	–
System description 3	–	–	X	–	–
Technical specification 1	–	X	–	–	–
Technical specification 2	X	X	–	–	–
User manual 1	X	X	–	X	–
User manual 2	X	X	X	–	–
User manual 3	–	–	X	–	–

Out of 20 documents 13 show signs of supporting multiple types of users either in regard to their purpose or their prior knowledge. However, it seemed to be rather rare that the document would support multiple purposes and multiple knowledge level simultaneously. Also, when different purposes are supported, it seems to be mostly limited into supporting two different purposes and not all three.

4.2 User personas based on the interview data

The user personas were modelled after the five different user groups that were interviewed in the course of this study. There was one persona created per each user group, so altogether five different personas were produced. Below I will first introduce each persona one by one and explain the choices I made during the creation process and what kind of features seemed to be prevalent in the interview data. I will explain my decisions further in section 4.3 while comparing the results from the two methods. The user groups and their personas are:

- Paola who represents the suppliers
- Sam who represents the manufacturers
- Tomas who represents personnel conducting product testing
- Gerhard who represents personnel conducting commissioning and maintenance
- Lukas who represents the end-users

The personas consist of a name, a photo, personal information, background information, job description, description of their documentation use, and a scenario. I decided not to use the word *scenario* in the personas so that the terminology would not be confused with the other meanings or associations of the word, so I will use a term “typical use case” to refer to them.

Personal information consists of the persona’s age, location, family, and job information. This is placed in the beginning, right under the name and next to the photo, so together they create an introduction into the persona. This also provides the means to emphasize with them as if they were real persons. Background information consists of the persona’s educational background, work history, and their experience in their current position. Someone’s current working position might not always directly signal what kind of prior knowledge they have, as education and prior work experience are also factor affecting it. Background information also allows me to emphasize that some personas have worked in the same position for a long time and others have just started. The job description consists of a short summary of what the persona’s responsibilities are. It may also include details about their habits, working environment, or something else that has a great influence in their work. The description of the way personas use documentation consists of four factors: time

used, most frequently used documentation types, purpose for using documentation, and personal preferences. Each of these factors helps us to understand better, how they use documentation, how much, and why. Finally, the persona sheet introduces a typical use case, in which the prior information will be utilized to create a situation in which these personas use documentation successfully. The use cases illustrate how personal preferences affect what personas do, what type of problems they may have, what helps them to solve them, and how the outcome is affected by them. The problems the personas face are things that were brought up during the interviews, so the use cases lay emphasis on things that could be improved, instead of something that already works. By explaining how different things directly affect the personas I hope to communicate that helping the personas to succeed in their tasks can save time and money, and also minimize the possibility of errors.

The first persona, Paola, represents the suppliers. This persona can be seen in Figure 4. She has relatively short experience in her current position but has longer work experience on similar companies. Although she represents the suppliers, she does not work in production herself, but she negotiates the contracts with other companies and uses documentation to make sure that

Figure 4. Paola represents the suppliers.

the specifications for the supplied product are in line with the contracts. Her work also includes planning the delivery project, which will be based on the documentation delivered to her. This means that successful documentation affects the entire project, and I hope realizing this could motivate the writers to pay attention to the documentation. The theme for her problem is version control. Many of the interviewees reported that they have had problems when a document was updated but updated sections were not marked clearly. In addition to having to use more time to figure out the changes, I think there is a risk that a piece of updated information might go unnoticed and even lead to faults in the final product. Another theme that defines Paola's way of using documentation is her habit of printing everything. This may also affect solving the problem with the updated documents, because she cannot use search function to find a key word that signals the updated part.

The second persona is Sam and he represents the manufacturers. Sam can be seen in Figure 5. He has the longest experience on the field and manifests features typical to experienced users. This is complemented by his personal trait of impatience that is heightened by his busy working environment. Although he has some similarities with Paola, as they both use

Figure 5. Sam represents the manufacturers.

documentation to create plans for manufacturing and transmit the information to other workers, he is one step closer to the manufacturing itself. He works with systems and makes sure that what they manufacture complies with the documentation. He also has people working for him that may come to him with problems, so in this regard his day-to-day tasks differ significantly from Paola's work.

The theme for Sam's problem is finding helpful information easily. Although Sam might want to skip information that is already familiar to him, his employees that use the same documentation may still need detailed instructions. The solution also highlights step-by-step instructions, which are rather central in technical communication and their use is also encouraged by the company. I hope that imagining Sam reading through a long excerpt of text instead of numbered steps will encourage the writers to use the recommended format for procedures.

The third persona is Tomas who represents the product testers. His persona can be seen in Figure 6. He works at the company that produces the documentation and is in fact not only a user but also a creator. In his job, Tomas uses, creates, and updates documentation.

This is the theme in Tomas's persona: user-creators. During the interviews it came up that many of the users are also creators when it comes to documentation. I thought

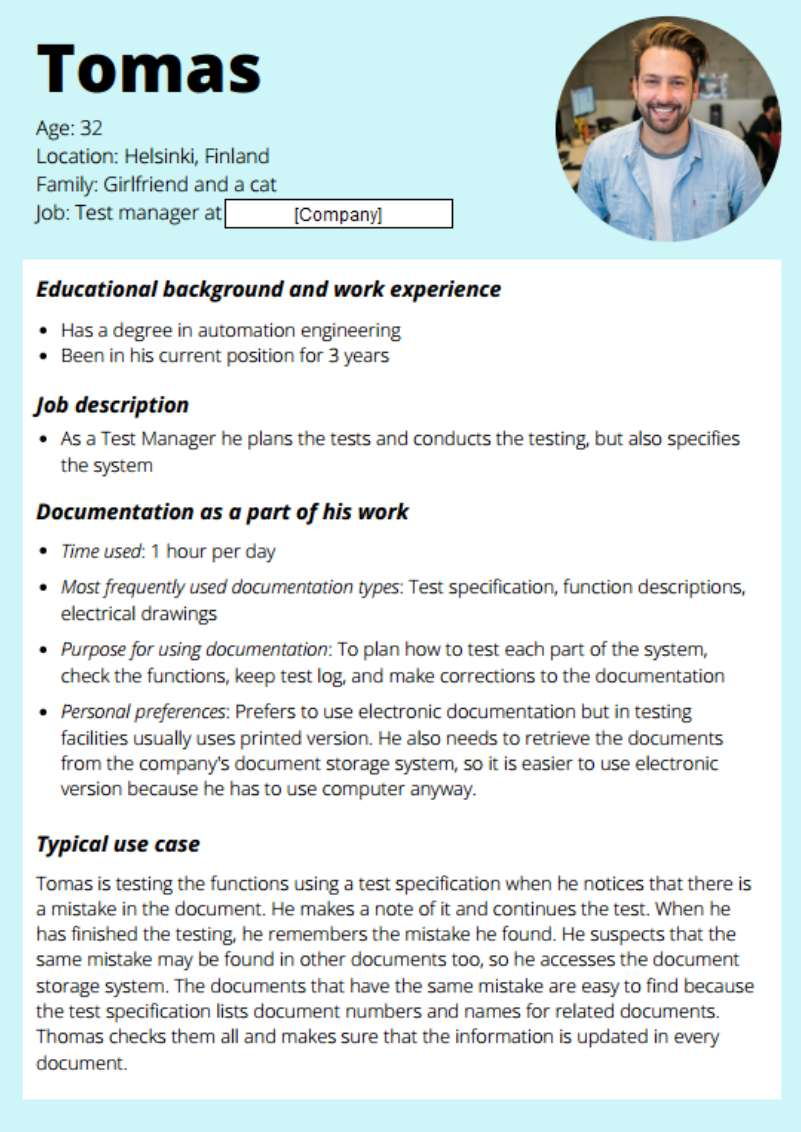

Figure 6. Tomas represents the product testers.

it would be most effective if the user-creator persona was an employee within the same company that will use these personas, as it would make it clearer, how the already existing documentation may affect other documents. It may also feel that the user is this way more familiar to the writers, which may encourage them to consider Tomas's problems more seriously.

The fourth user persona is Gerhard and he represents the personnel who conduct commissioning and maintenance. This persona is represented in Figure 7. Like Tomas, he also works for the company that creates the documentation, but his work in very different from Tomas's. Gerhard helps to commission the final product, which means that he oversees that the manufacturing is done accordingly and that the final product is what it should be. He also conducts maintenance once the products have been finished and taken into use.

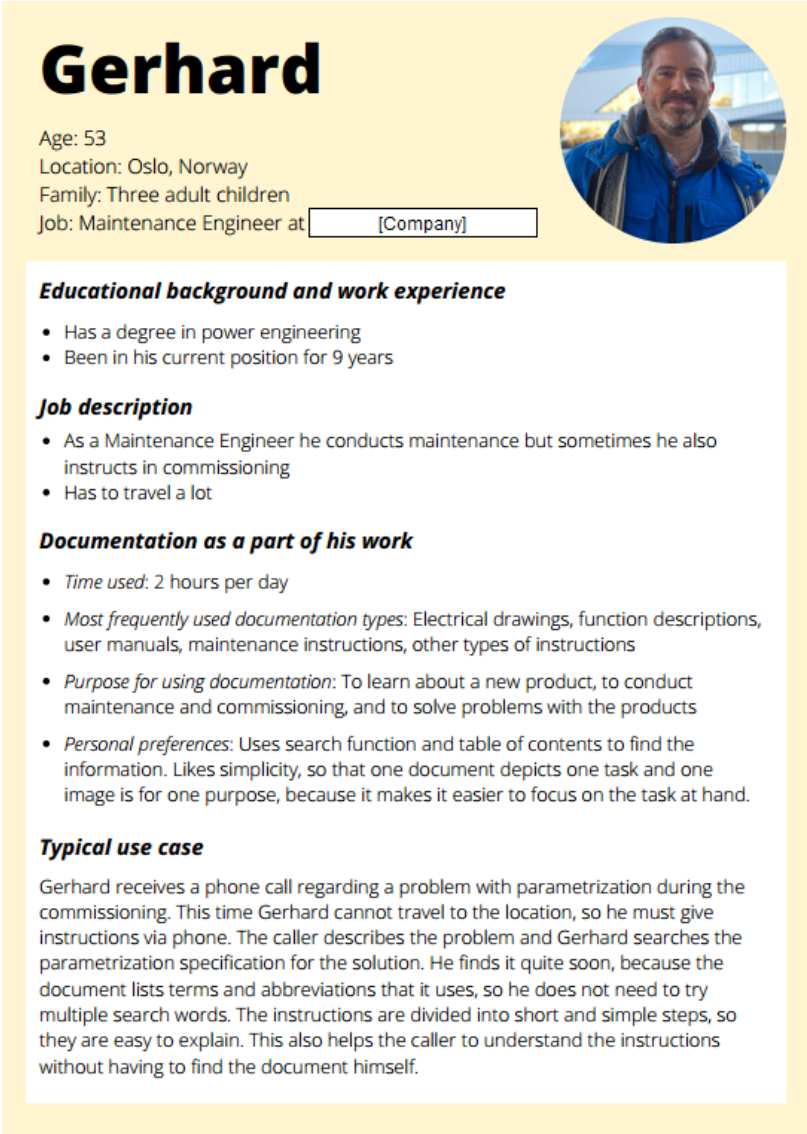

Figure 7. Gerhard represents the personnel who conduct commissioning and maintenance.

The theme in this persona is understandability, and it is illustrated first with introducing terms and hence making it easy for the user to find the best search words, and later it is referenced when maintenance instruction has to be given via phone in a way that the recipient understands what they need to do. Terminology came up during the interviews and even though none of the interviewees

said that they had trouble understanding the terminology used in the documentation, they did mention that sometimes they have troubles finding the right search words, because different companies sometimes use different words for the same thing. One of the interviewees also expressed his opinion that simplicity in documentation helps him to understand the information better, so it became one of the preferences for Gerhard.

The fifth and the final user persona is Lukas, who represents the end-users. This persona can be seen in Figure 8. Lukas works on a ship that has technology designed by the company that also produces the documentation. There are again some similarities with the other personas, especially with Gerhard, as Lukas also conducts maintenance. However, his working environment is very different from all the other personas.

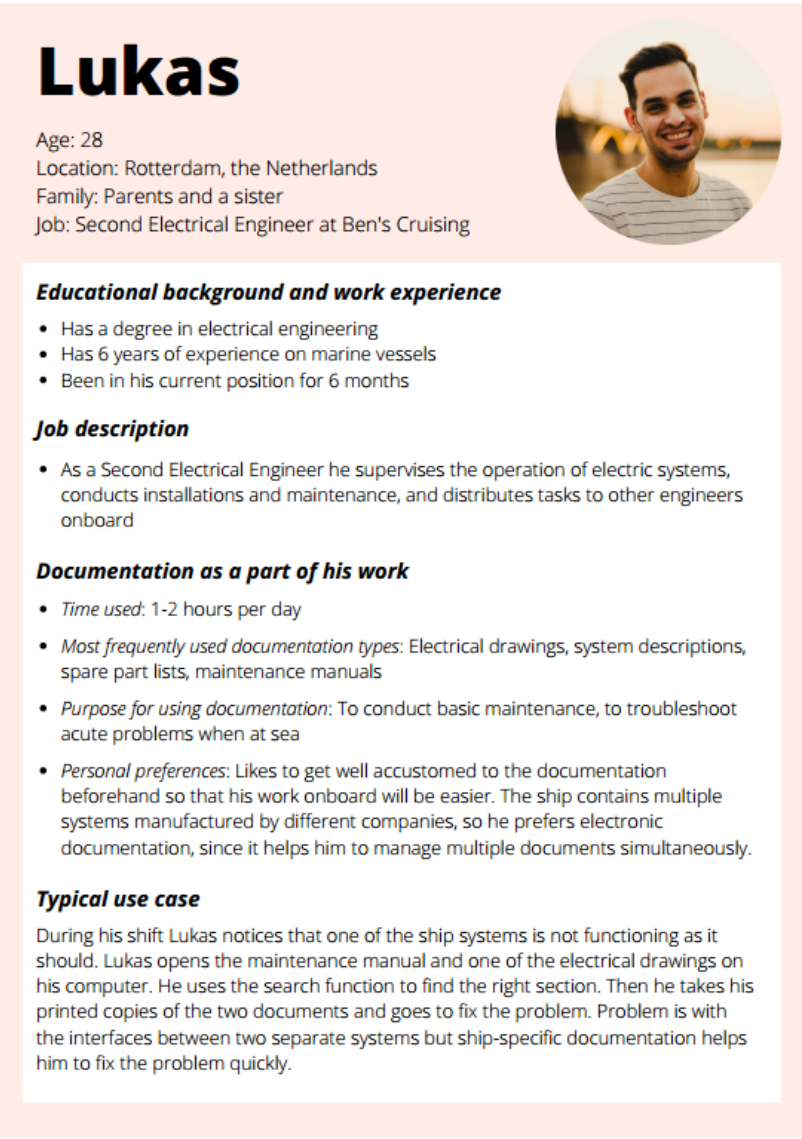

Figure 8. Lukas represents the end users.

The theme in this persona is compatibility. As illustrated with Lukas, the reality is that very rarely the final technical product is only used with other products produced by the same company, but rather the products are used together with other products from different companies. This is therefore the case with the documentation as well. The end user that was interviewed mentioned interfacing between different systems as an aspect that sometimes

causes trouble. The theme of compatibility is also featured in the typical use case with the project specific documentation. This was an aspect that was mentioned by many different user groups: even though there is a standard version for a product, the final realization is very rarely something that is completely identical with it. That means that standard documentation may not match with the final product in all aspects, which can understandably create problems.

Overall, the interview data was rather similar between all the different user groups. Most of the differences were related to the documentation types they used and their own work tasks. There were no drastic differences between user groups, and I was even slightly surprised how much similarities they had. This is reflected in the personas as well, although I tried to make every persona have their own unique qualities that affected their way of using documentation. This also led me to create almost like a continuum from the first persona to the last: Paola negotiates the deals, Sam plans the manufacturing process, Tomas tests a product, Gerhard advices when the product is been taken into use, and finally Lukas deals with problems with the finalized product. So even though there might be differences between suppliers when they manufacture a part and when manufacturers combine all different parts into a finalized product, I reasoned that I could create more variety by also addressing different phases in the lifecycle of the product.

4.3 Differences between the results and assessment of their indications

In this subsection I will first summarize the main findings regarding the heuristic evaluation and user personas and assess the differences between the results gained with the two methods. The results can be divided into three main themes: the knowledge level of the users, users' purpose for using the documentation, and the support for multiple knowledge levels or purposes within a single document. These themes surfaced during the inscription-based heuristic expert evaluation in section 4.1 and I will conduct the comparison by assessing similar factors in the user personas as well as the

user interviews that were used as their basis. Finally, I will interpret the results and assess how they affect the ways these two methods could be utilized together in the most beneficial way.

The results suggested that despite having different topics the documents belonging to the same documentation type shared many similarities. Further similarities could be found between related documentation types, such as different types of descriptions. In order to summarize the results here and to conduct the comparative analysis, I will group the different document types under a more general class of document types instead of addressing all nine document types separately. Function description and system description are combined under *descriptions*; installation instruction, instruction, maintenance instruction, and operating instructions fall under *instructions*; requirement specification and technical specification are combined into *specifications*; and user manual is referred to as *manuals*.

Firstly, regarding the knowledge level, heuristic evaluation suggested that approximately half of the documents appeared to require some form of expertise to be used effectively. Some of the document types seemed, however, to be more likely to require expertise on the subject. A summary of the results can be seen in Table 8.

Table 8. Classes of documentation types and their likelihood for requiring expertise.

	High likelihood for expertise	**Moderate likelihood for requiring expertise**	**Low likelihood for requiring expertise**
Descriptions	1 / 6	4 / 6	1 / 6
Instructions	1 / 7	3 / 7	3 / 7
Specifications	1 / 4	1 / 4	2 / 4
Manuals	1 / 3	0 / 3	2 / 3

Descriptions seem to be most likely to require expertise, as five out of six documents were estimated to have moderate or high likelihood of the inscribed user being a specialist. With instructions and specifications about half of the documents seemed to require prior knowledge on the subject, and with manuals only one of the three documents appeared to require expertise from

its inscribed user. This shows that there are some fluctuations between documents within the same document types but even more so between different classes of documentation types.

However, when personas are assessed against this same criterion of knowledge levels, the differences are minimal. All 13 interviewees reported having a degree in engineering, which they also saw as being very typical for someone working in their position. Therefore, I made all the personas as experts in rather similar fields: all of them have an engineering background, so it would be probable that they would be equally capable of understanding documentation which requires prior knowledge on engineering.

Secondly, regarding purpose, even clearer patterns between different classes of document types surfaced during the heuristic evaluation. The purposes covered in the analysis were: practical application, referential use, and learning purpose. Table 9 presents a summary of these results.

Table 9. Classes of documentation types and purposes they support.

	Supports practical application	**Supports referential use**	**Supports learning purpose**
Descriptions	0 / 6	1 / 6	6 / 6
Instructions	7 / 7	2 / 7	0 / 7
Specifications	2 / 4	3 / 4	1 / 4
Manuals	2 / 3	2 / 3	2 / 3

Descriptions seem to be clearly linked with learning purpose as all its six documents had either moderate or high likelihood of supporting it. None of them supported practical application and only one document out of six supported referential purpose. Instructions on the other hand clearly supported practical application, as all seven documents scored moderate or high likelihood of supporting it. Two out of these seven documents were likely to support referential purpose, and none supported learning purpose. Specifications had more variation, but referential purpose seemed to be most prevalent, as three out of four documents supported it. Two of the documents seemed to support practical application, but the likelihood was only moderate, whereas two out of three

documents indicating referential use scored high likelihood. One out of four specifications seemed to indicate support for learning purpose. Lastly, manuals were the most diverse group regarding the purposes they supported. Each purpose had two documents supporting it with either high or moderate likelihood, so it seems to indicate that manuals are fit to support all three purposes, even simultaneously.

All these three purposes were also present in the interviewees' answers, so they were incorporated into the user personas as well. However, as the interviews consisted of mainly open-ended questions and I did not refer directly to these three purposes, they had to be decoded from the descriptions the users gave regarding their ways of using the documentation. This meant that the purposes depicted in the user personas are also more subtle and not as clearly separated from one another. Practical application was one of the clearest purposes to decode and it was very popular in the users' answers, which is why I included it as a purpose for four out of five personas – for everyone except Paola. I incorporated referential use for two out of five personas – Paola and Sam. Comments suggesting referential use were frequent in the interviews. For example, ten out of 13 interviewees mentioned that they use electrical drawings and their answers suggested referential purpose, but it did not seem to be the most important purpose for them in regard to documentation use overall. This is why I implied referential use only implicitly in the other personas. Learning purpose also had to be mostly inferred from the interviewees' answer, although some did mention it explicitly as one of their purposes. Hence, I included it in three out of five personas, Paola, Gerhard, and Lukas. Most of the interviewees did not state which documentation types they use for learning, although one of the interviewees did mention system descriptions in this context. This would be in concordance with the results from the heuristic evaluation.

Thirdly, in regard to the support for different knowledge levels and purposes there were differences within the documents of the same documentation type. There did not appear to be a clear pattern that could be used to predict whether the document would have features that supported

either multiple purposes or knowledge levels. There was one exception though, as five out of seven instructions indicated moderate likelihood for supporting users with different knowledge levels. All the other classes had one document each that suggested support for multiple knowledge levels so there was no clear pattern within them. As observed earlier, manuals appeared to be able to accommodate all three purposes, and two out of three manuals scored moderate or high likelihood of supporting multiple purposes. Two out of four specifications also suggested support for multiple purposes, but as noted earlier, their likelihood for supporting practical application was lower than likelihood of supporting referential use. However, it could be inferred that the main use is intended to be referential and practical application only additional.

This aspect is very difficult to assess from the point of view of the user interviews, especially in regard to the support for different knowledge levels, as users cannot easily assess this. The interviewees stated multiple different purposes, though, so it is possible that they can use one document for more than one purpose. There are nevertheless no clear observations to be made about this, as the interviews I conducted did not produce information about this aspect. If the goal was to find out more in detail which document types are used for which purposes, I would suggest that this was covered more in detail in the interviews. Due to the schedule of this study, I conducted interviews simultaneously with the heuristic evaluation, so I could not address observations that surfaced during the evaluation. If heuristic evaluation was conducted first, interview questions could be designed to cover similar aspects, which would help to counter this shortcoming. Alternatively, a completely different approach could be used to assess different document types and user purposes, perhaps in the form of usability testing.

All in all, although it cannot be said that the results gained from the two methods contradicted each other, their points of view were so different that it was difficult to compare the results – even with the focus of heuristic evaluation being adjusted to match the user-centric focus of user personas. As perhaps could be expected, heuristic evaluation did not provide as detailed information

about the users as the interview process and user personas did; rather, it outlined the general qualities of the inscribed user. Also, it illustrated the differences in typical knowledge levels and purposes between different document types. Interviews and user personas on the other hand provided detailed insights into how individual users might utilize the documentation and what kinds of everyday problems they solve with it. However, with one method producing general and the other detailed information I think the two methods could support each other when combined.

As regards to the ways in which they could be combined with most beneficial results, I think that especially data-based user personas are a good way of bringing information about the real users into the design process. The inscription-based heuristic evaluation can illustrate the general types of users in regard to their knowledge levels and purposes that are supported by the documentation. In the manner of any heuristic evaluation, the heuristics and the questions I have modified to fit the inscription-based version of the original could, according to my estimation, be used either as a supporting tool while compiling the documentation or as an inspection method to evaluate finished documentation. In my opinion, inscription-based heuristic evaluation could maybe be best utilized by using it to make the writers more aware of how their decisions affect the supported knowledge levels and purposes of the documentation. User personas on the other hand could be utilized throughout the documentation process, as it would make the users more concrete in the writers' minds and simultaneously act as a reminder in regard to the aspects that need to be supported.

The combination of these two methods might also be helpful when the overall documentation process is planned and the content of documentation sets are being decided upon. User personas help to envision user needs which need to be covered with documentation and inscription-based heuristic evaluation can be used to assess which documentation types would be most typically best to answer these needs. Also, it could be used to evaluate the finalized documentation set to see, if it indeed covers all the required aspects.

5 Conclusion

Both heuristic evaluation and user personas are widely used to improve usability, but their possible benefits in combination has not been studied extensively. Prior studies on the matter have suggested that identifying the user personas first could improve the use of heuristic evaluation and result in better understanding of quality issues (Dantin 2005, n.p.). However, there has not been systematic comparison between the two methods to see what kind of information they can produce if the focus is the same. Neither has this combination been viewed from the point of view of technical communication, so it has been unclear if same benefits could apply to technical documentation.

My main focus was on the data and methodology, so theoretical background is covered rather briefly in this thesis. The purpose of this study was to cover the comparison between heuristic evaluation and user personas that has been missing on the subject and also address the aspect of technical communication in this context. I aimed to use the results of this comparison to discover how heuristic evaluation and user personas could be best utilized together to gain a wider view about the users and aspects that support them in technical documentation. As technical documentation usability is directly linked to how well the intended audience matches the actual users (Jayaprakash 2008, 245), the combination of these two methods could help to achieve better usability. My approach was to first focus the heuristic evaluation on user qualities by creating a new method to uncover qualities of the inscribed users. The results of this inscription-based heuristic evaluation were then compared to user personas created on the basis of user interviews to find out, if the results differed from each other. Finally, the results were assessed to evaluate how the two methods could be combined in the most beneficial way.

The results showed that there were differences between the two methods. Inscription-based heuristic evaluation produced information relating to the users' typical knowledge levels and purposes linked to different documentation types, and user personas provided detailed information about the day-to-day routines of the real users and their individual preferences regarding

documentation. In some parts the results could not be directly compared as they were very different in nature, which illustrates some of the challenges faced in the course of this study.

As for the best way of combining heuristic evaluation and user personas, I do not think my findings are so conclusive that I could present one style of application that would be better than any other, since different situations and companies may benefit from different approaches. Also, as both heuristic evaluation and user personas are somewhat flexible tools, I think there are many good ways of combining them. Nevertheless, I think that based on the results in this study the combination of the two methods can be used to ensure that different points of view are covered: heuristic evaluation can tell which knowledge levels and purposes the documentation supports, and user personas can present information about the real needs of the users.

In contrast to prior studies on the subject, my approach was more systematic, and it also tried to counter two of the most typical pitfalls in heuristic evaluation that were introduced in section 2.1: vague goal analysis and vague evaluation procedure (Hertzum and Jacobsen 2001, 434). Prior studies (Friess 2015, Chisnell et al. 2006, Dantin 2005) which have used the two methods together utilized personas mainly as a way to remind the evaluators about users' needs. As stated in section 1, although all the studies reported that combining user personas with heuristic evaluation seemed to produce good results, I think their methodology could be criticized for a vague evaluation procedure. This type of flexibility in the evaluation process is inherent to heuristic evaluation, but Hertzum and Jacobsen (2001) strongly suggest having a clear evaluation procedure, which is what I tried to cover with the combination of inscription-based heuristic evaluation and its clarifying questions, which help the evaluators to evaluate each document more systematically.

Also, even though the inscription-based heuristic evaluation focused on user qualities and I outlined the procedure for the evaluation rather clearly, it was sometimes still near impossible to compare the results to the user personas. Therefore, I think that without clearly structured procedure for utilizing heuristic evaluation and user personas together the evaluator effect might be

heightened. I do not think that the vague goal analysis is a problem, as utilizing user personas in any way could address it, but without clear procedure for the evaluation combining both methods the vague evaluation procedure would remain as a problem.

The subject of my study was technical documentation, whereas the prior studies focused either in user interfaces of web pages, so results in this study might not be directly applicable to other fields. Also, my experience with the difficulties in the course of this study cannot be interpreted as a proof that heuristic evaluation and user personas are inherently difficult to combine, as it may be due to unrelated problems with this study. Developing specifying questions for the inscription-based heuristic evaluation was in my opinion extremely helpful during the evaluation but inventing suitable questions that would cover all necessary aspects was rather difficult. As mentioned in section 3.1.2, the concept of inscription has been studied to some extent even in the context of technical communication (e.g. by Suojanen 2018), but it has not been combined with heuristic evaluation. I think that if there were further studies that better outlined the ways inscription can be detected in technical documentation by utilizing heuristic evaluation, the details I included into the evaluation procedure could be refined.

Also, as I planned the questions for the user interviews before I knew the full results of the heuristic evaluation, my questions did not distinguish between different types of purposes. If I had known about the themes surfacing in the inscription-based heuristic evaluation, I could have covered the nature of the users' purposes in more detail. This suggests that it could be beneficial to conduct the heuristic evaluation first and design interview questions using it as a reference. On the other hand, I think this issue also emphasizes the number of factors that should be accounted for when two such different methods are combined. The process I used to identify the important user groups was also fairly informal and unstructured, and even though I think it worked in this situation, I think that a more structured method could be more reliable. Not all user groups could be included, which is an inevitable part of every creation process of user personas, but it also creates a situation

in which the excluded user groups could have proved to be entirely different in all regards when compared to the personas that were created.

This study was conducted in cooperation with a company which provided the technical documentation used in the inscription-based heuristic evaluation and users that were interviewed for collecting data for the user personas. This means that the case study is based on real products, real documentation, and real users. However, this also means that the findings, especially those from the heuristic evaluation, are company-specific and not directly applicable to other situations. However, the methodology used in this study can be applied to different situations where there is a need to learn about the inscribed user in the documentation and compare it to real user data.

Nevertheless, combining the inscription-based heuristic evaluation and user personas in a way I have done in this study could help to make heuristic evaluation more user-centric, counter some aspects of the evaluator effect, and help to assess if the documentation supports the needs of the personas. I also think that the combination of these methods can also be used to make the documentation process easier. In this study different purposes were usually linked with specific documentation types. This could help a company to plan the documentation set for a specific product in a way that all the required knowledge levels and purposes are covered. However, further studies would need to be conducted to find out how applicable the results of this study are. Yet, even though different companies may use documentation types in slightly different ways, it is possible that some basic features for each documentation type remain the same regardless.

Overall, I think that inscription-based heuristic expert evaluation and user personas would yield notable benefits in the context of improving usability of technical documentation. Regarding further studies, inscription in the context of heuristic evaluation would be in my opinion a very useful subject. Also, comparing the results when heuristic evaluation is conducted first as opposed to when it is conducted after creating the personas could help to identify a methodology that grants best results.

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Appendix A: Interview questions for users in persona phase

*”In this context **documentation** means all text- and image-based material provided by [company], such as technical specifications, function descriptions, system descriptions, electrical and mechanical drawings, and different types of instructions relating to – for example – installations, operating, maintenance, or safety.”*

Background information

1. What is your educational background?

2. What kind of tasks does your job consist of?

3. Do you consider your background (including education, work experience, and language skills) to be typical in this kind of position?

4. How long is your experience from marine industry / working with marine industry?

General questions regarding the use of documentation

5. How often do you use documentation and how long periods at a time?

6. In what kind of working environment do you use documentation? (e.g. in office, on site)

7. What type of documentation do you use most often? (e.g. instructions, specifications, mechanical or electrical drawings)

8. For what purpose do you use documentation? (e.g. to gain knowledge, to perform a task)

9. In which forms do you use documentation? (electronic / printed) What kind of things affect this choice?
    a. [If electronic:] PDF, Word, something else?
    b. [If electronic:] Which device do you use to read the electronic documentation?

10. How do you use the documentation? (e.g. do you read it all the way through, do you eye it through, do you read only specific sections, do you search for a specific piece of information)
    a. [If not reading all the way through:] How do you search information from the documentation? (e.g. table of contents, eyeing through, CTRL + F)

11. What is your overall experience when using [company] documentation?

Questions regarding documentation usability

12. Regarding [company] documentation at this moment, what do you think is good and what could be improved? Consider following aspects:

    a. Can all the necessary information be found easily or is some important information either missing or difficult to find?

    b. Are the contents of documentation relevant (not too much information and not too little), easily understood, does it match with the product, and is the order of information logical?

    c. Does the documentation help to succeed in the desired task?

    d. Is the general layout of documentation pleasant and easily approachable?

    e. Do figures and images support the use of documentation? Is the number of figures suitable? (not too many but enough)

13. What is the most important thing for you in documentation? What are your wishes regarding documentation?

14. How would you rate the quality of [company] documentation compared to documentation produced by other companies?

Finishing questions

15. Do you have something else you would like to bring up regarding documentation that has not come up yet?

16. Do you have some questions or comments relating to this interview?

Appendix B: Background information form

Age:

[ ] 18 – 25
[ ] 26 – 33
[ ] 34 – 41
[ ] 42 – 49
[ ] 50 – 57
[ ] 58 – 65
[ ] over 65

Gender:

[ ] Male
[ ] Female
[ ] Other / I don't want to tell

Job title:

_____