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IMPROVING THE USABILITY OF WASTE MANAGEMENT SYSTEM VIA PERSONAS

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ABSTRACT

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Knowing the users and their goals is critical when building a product that users find desirable and easy to use. When the users and their goals are preserved in usable format, design decisions can be based on user data. Regardless of the vast research in the area, many companies struggle to create products that are pleasant to use.

The goal of this thesis is to gather information about the users of a waste management system called Wasteado to understand how the system is used, and to use this knowledge to improve the usability of the system.

This thesis presents a case study of collecting user data using contextual interviews and condensing the data to personas and scenarios. The study targets two roles from Wasteado, scale operators and carriers. The collected data is analysed to find common behaviours and motives between groups of persons in the same role. Personas are composed based on observed behaviours and motives of a group of similar people. The story of personas is elaborated by creating persona-based scenarios, that depict the ideal interactions of personas using the system. Together, the personas and scenarios are used to evaluate possible pain points in the current system by finding the most important interactions and evaluating how the system currently acts in relation to the ideal scenarios.

The study deepened knowledge of the users of Wasteado, and the results guide the design to be more user-centered, but also raise the importance for further research. Contextual inquiry appeared to be a useful method when collecting user data from a small number of interviewees, but other approaches may be more beneficial for larger groups. Personas and scenarios proved to be a potent way of describing users and their activities, as their narrative style is highlighting users' goals and bringing the environments visible and tangible, making it easier for the development team to understand the reasons and motivations behind the users' actions, which essentially leads the design to serve the user better.

Key words and terms: user-centered design, personas, scenarios, usability

TERMS AND DEFINITIONS

This section lists the terms and definitions used in the thesis.

Wasteado	A pseudo-name of the waste management system under inspection
SME	Subject Matter Expert, a person with domain knowledge
UI	User interface
UX	User experience

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1 Introduction

User-centered design has been around for a few centuries, with wide use beginning from Donald Norman's *User-Centered System Design: New Perspectives on Human-Computer Interaction* (Draper & Norman, 1986). Alongside Norman's seven principles, Ben Shneiderman (Shneiderman & Plaisant, 1987) suggested eight golden rules for better user interface design. Later in 1993 Jakob Nielsen helped popularizing the concepts to produce heuristics for usability engineering (Nielsen, 1994a). All these works have aimed to improve the usability of software products by guiding the design to be user-centered.

Since then, various approaches to improve usability of software through user-centered design have been suggested, such as *personas* (Cooper et al., 2014), that try to establish a connection between designers and real users and *scenarios* (Carroll, 2000) that aim to tell developers stories of how users want to use the product. Regardless of the vast amount of research in the field, the apparent absence of applying design by the principles has resulted in many products having poor usability, and people struggling with daily use of various software.

This thesis presents a case study aiming to improve the usability a waste management system. For the purpose of keeping business data secure, a pseudo-name Wasteado is used throughout the thesis. The user data is gathered through contextual interviews and personas are created based on the collected data. The created personas are analysed, and together with the research data, ideal scenarios are constructed. Finally, the current design is evaluated through the personas and scenarios, and improvements are suggested.

Most of the current knowledge of users of Wasteado is not in any form, but remains more of tacit knowledge, leaving room for interpretation errors, even potentially risking losing the data completely. The benefits of sharing tacit knowledge are numerous, as it increases efficiency in decision-making, improves quality and accuracy of work and may lead to major time savings (Haldin-Herrgard, 2000).

Furthermore, the user research of Wasteado has been focusing more on gathering data from Subject Matter Experts (SME), who possess knowledge of the waste management domain, legislation etc, and customers, who purchase the product. This leads to potential problems, as the current data might not properly represent the actual users of the system, leading to poor day-to-day usability of the product. The distinction between the customer,

the SMEs and the *user* of the system is sometimes subtle, but usually they are different persons. Customers might be able to articulate the needs or describe the problems the system should solve, and SMEs might have a lot of domain knowledge, but it might be neither one uses the system, or does so in a daily basis, like the user does (Cooper et al., 2014). It is of course important to hear the opinions from broad take of stakeholders, but when planning the design, users should have the final word.

Collecting the existing user data to personas helps to preserve the current knowledge of users, transfer the tacit knowledge of users to the development team, understand the users' perspective to the system and analyse the current designs and how they could be improved. Scenarios bring in tangible use cases, stories of users using the product, allowing analysis of the usability from many points of view. Furthermore, after the personas are applied successfully to the old data, grounds have been established for seeking new types of users and developing the system to better serve their needs, without forgetting the needs of initial users.

Alongside gathering and preserving user data, another goal of the thesis is to deepen the knowledge of user-centered design to be able to apply practices in future projects, as well as to find out, whether if personas are suitable way of preserving user data.

In Section 2 we will take a closer look to contextual interview, personas, scenarios and how they should be built through literature review. Section 3 presents how user analysis was conducted and constructing the personas and scenarios. Section 4 shows how the personas help to evaluate current designs via building scenarios, and Section 5 sums up the results and experience gained as well as suggests further improvements and research.

2 User-centered design methods

This section revises existing research through literature review. First, I investigate the current research of goal-directed design as well as why it is considered a good practice. Section 2.2 introduces contextual inquiry, a method used to gather data from users. In Section 2.3 I will examine condensing the collected data to personas and the benefits of personas. Section 2.4 discusses the creation of scenarios and presents them as supportive structure alongside personas, while Section 2.5 focuses on how to turn scenarios into product requirements, while keeping users in mind.

2.1 Goal-directed design

In the 1980s, Norman (1988) developed user-centered design in *The Psychology of Everyday Things* (POET; renamed to *The Design of Everyday Things* in 2002 republish) (Norman, 1988; Norman, 2002). Emerging from his frustration of the difficulty of using everyday things, Norman harnessed his knowledge of experimental psychology and cognitive science, and approaches design by showing examples of poorly designed objects and how they could be improved. Norman argues that the same principles apply for software as well, and offers four basic suggestions on design:

1. Make it easy to determine what actions are possible at any moment (make use of constraints).
2. Make things visible, including the conceptual model of the system, the alternative actions, and the results of actions.
3. Make it easy to evaluate the current state of the system.
4. Follow natural mappings between intentions and the required actions; between actions and the resulting effect; and between the information that is visible and the interpretation of the system state. (Norman, 2002, p. 188)

The main point of the design suggestions is to try to place the user at the center of the design, whereas it is up to designer to make the product behave in the manner the use expects. In short, the user of the object or software should know what to do with it, and what is the result of use. As Norman (Norman, 2002) describes deep frustration and the feeling of inadequacy when using poorly designed objects, adding Cooper and others' design principle, "Don't make the user feel stupid." (Cooper et al., 2014, p. 81) to the list would make it even more complete.

Following the suggestions, Norman (1988) gives seven *principles* to help designers strive for better design. In late 1980s, apart from Norman, Ben Shneiderman (Shneiderman & Plaisant, 1987) presented similar set of eight golden rules. Later in 1990s Jakob Nielsen (1994a) continued the work, producing the well-known ten usability heuristics. Today the heuristics themselves remain unchanged, but are nowadays presented and elaborated with examples by Norman's and Nielsen's co-founded UX research and consulting company, Nielsen Norman group (Nielsen, 1994b):

1. *Visibility of system status*. Keeping the users informed about what system is doing and providing feedback.
2. *Match between System and the Real World*. Using words and phrases user is familiar with, following real-world conventions and presenting data in natural and logical order.
3. *User Control and Freedom*. Support undo and redo -functionalities, provide user a way to cancel actions without extended process.
4. *Consistency and Standards*. Maintain consistency within product or product family. Follow platform and industry conventions.
5. *Error Prevention*. Prevent errors from occurring in the first place. Support users with providing good default values.
6. *Recognition Rather Than Recall*. Minimize user's memory load by providing information where it is needed, e.g. in-context help.
7. *Flexibility and Efficiency of Use*. Provide shortcuts to advanced users. Allow customization.
8. *Aesthetic and Minimalist Design*. Remove irrelevant or rarely needed information and keep visual design focus on essentials. Prioritize content and features to support primary goals.
9. *Recognize, Diagnose, and Recover from Errors*. Use natural language instead of error codes. Indicate the problem accurately and provide a solution.
10. *Help and Documentation*. Design should explain itself, but if necessary, provide users preferably with in-context help. (Nielsen, 1994b)

The principles aim to improve the usability of the system, "the quality of a system with respect to ease of learning, ease of use and user satisfaction" (Rosson & Carroll, 2002, p. 9), and lead design to focus on the user (Cooper et al., 2014). Nevertheless, even today the term design usually means the looks of the user interface (Holtzblatt & Beyer, 2016).

Building a successful product requires research about the users of the product. To be able to understand a user and design for the user, it is crucial to recognize the goals, motivations and environments of the user (Cooper et al., 2014). In *About Face: The Essentials of Interaction Design* Cooper and others. (2014) point out four main reasons why products fail often: misplaced priorities, ignorance about real users, conflicts of interest and lack of a design process.

Firstly, misplaced priorities refer to the fact that, traditionally marketers and developers are in different teams. While marketing does the research, they focus mainly on what sells well to potential customers, which leads to collecting lists of requirements for system. This list of requirements lacks the users' voice, leaving the needs and desires of users' out of the list. Furthermore, customers, nor users, can articulate their true needs properly, so the requirements might represent something completely different than the users' needs. (Cooper et al., 2014)

Cooper and others also speak of ignorance about the real users. Oftentimes the research is focused on demographics of the users, resulting in knowing the age, gender and possibly even general behaviours, but the data lacks knowledge of how the users operate the product, why they are using it in the first place or why they chose the product over competitors' product. (Cooper et al., 2014)

Developers on the other hand, have a say in the final form of the product and have insight on how the product behaves but are left without knowledge of who operates the product and why. Developers' work revolves around solving technical issues to fulfill requirements, meeting deadlines, maintaining good engineering practices and growing codebase, leaving little room for thinking the users' perspective. Additionally, as Cooper and others later mention, creating usable products requires time, and deadlines usually result in selecting ease of coding over ease of user, especially since managers do not see the benefits of usable product—and how could they, since they are not aware of the users? Thus, while marketers and developers are the most able persons to affect the products behaviour, they are rarely aware of the users' goals, needs or motivations, leading to products that lack usability. (Cooper et al., 2014)

Finally, Cooper and others raise the lack of a robust design process as an issue that leads to poor usability. Companies might have proper development and testing processes to

ensure the feasibility and quality of the technology, but it all makes little use if the product itself is not desirable on the users' perspective (Cooper et al., 2014).

When trying to understand the users, many companies also mistake domain knowledge for design knowledge by assuming the customers or SMEs are the key of solving design problems. It is of course important to gain knowledge from all stakeholders, but the needs of each stakeholder should be filtered through a professional designer, since design is specialized skill just like marketing or software development. This is because while customers might be able to point out the problems, they might not see a proper solution clearly, and while SMEs might be able to visualize solutions, they might not be usable for the less-experienced users. After all, if a patient proposes removing appendix due to stomach-ache, a responsible physician does his own research, using his professional knowledge to make the diagnosis and prescribe the treatment, before starting any procedures. (Cooper et al., 2014)

Cooper and others tackle all these problems by guiding the development to be more user-centered via personas introduced better in Section 2.3, but to further understand goal-directed design and how it addresses the problems presented, it is first important to understand the nature of users' *goals*. Goals are, after all, the heart of personas.

2.1.1 User goals

Users' goals often differ from what one thinks they might be (Cooper et al., 2014). A designer might think for example, that cashier's goal is to serve customers efficiently. This, however, is most likely the goal of the cashier's employer instead. The cashier's goals might be more in the line of being kind to customers and keeping up the good work while performing routine and repetitive tasks. When asked, the cashier could still reply that his goal is to serve customers efficiently; it should be acknowledged that users might not be consciously aware of their own goals, or that the users might not be able to describe their goals (Cooper et al., 2014).

When design meets the user's goals, business goals are achieved far more effectively. This is often not acknowledged by companies, leading to products that do not fulfill user goals, since companies focus more on users' tasks instead of paying attention to goals. When businesses finally do acknowledge users, it is often too late to change the product

to serve these goals. It is important to acknowledge tasks, and while focusing on tasks only may provide sufficiently working product, it oftentimes leaves users unsatisfied, since their goals are not addressed. If user's task would be to enter 5000 names into database, an automated system, that fetches and saves the names automatically to database serves the user way much better than smoothly functioning input form. (Cooper et al., 2014)

Then what is the difference between tasks and goals? Users engage in activities consisting of one or many tasks, in order to reach their goals. Goal is the expectation of an ending condition of completed task or activity. Since goals are mostly driven by human motivations they change slowly and are not related to technology at hand, while tasks change faster. In short, tasks answer what user is doing, while goals answer why the user did it in the first place. An example of differences between goals and tasks could be a businessman travelling. His goal is to travel fast and comfortably, and most likely would lead to booking tickets to business-class flight. If we go back in time to 1900's, similar businessman could have the exact same goals—travelling fast and comfortably—but his activities would relate to getting a horse and a decent covered wagon. (Cooper et al., 2014)

Since goals are more persistent than tasks, focusing the design on goals instead of tasks leads the design to also be more persistent to changes. The activities may be streamlined and automatized, since it is easy to see which tasks are not relevant for the user in the path of reaching the goal with minimum effort. (Cooper et al., 2014)

It should be acknowledged though, that there are different types of goals. Norman (2004) argues that successful design should address visceral, behavioural and reflective levels of cognitive and emotional processing. To better integrate these to practical level of designing, Cooper and others (2014) present three types of user goals, namely *experience goals*, *end goals* and *life goals*.

Experience goals express how the user wants to feel when using the product and address to visceral level processing. Visceral processing is the most immediate level of processing, and it is superficial by nature (Norman, 2004). This level of processing tells how persons react to sensory aspects, such as visual elements, and it helps us to make decisions quickly; whether things we perceive are safe or dangerous, good or bad (Norman, 2004). Thus, experience goals provide focus for product's visual and aural characteristics and interactive feel (Cooper et al., 2014).

Behavioural processing constitutes most of the human activity, and as the middle level of cognitive processing, it influences visceral processing and is influenced by reflective processing (Norman, 2004). End goals address to behavioural processing, as they represent the user's motivation for performing tasks associated with using the product (Cooper et al., 2014). End goals are the most significant type of user goals when determining the product experience as they essentially express what the user wants to do (Cooper et al., 2014).

Life goals represent deeper and longer-term motivations of the user. These goals correspond to the deepest level of cognitive processing, the reflective level, which involves conscious reflection on past experiences (Norman, 2004), and they thus rarely affect the design directly (Cooper et al., 2014). Life goals typically reach beyond the context of the product but addressing life goals can improve the loyalty of the user, so it is worth keeping them in mind (Cooper et al., 2014).

2.1.2 Nonuser goals

Apart from user goals, design might be influenced by different stakeholder goals, such as customer, business, organizational or technical goals. These goals are referred to as *nonuser goals* (Alexander, 2005; Cooper et al., 2014).

A nonuser goal is an intention a stakeholder has for the product (Alexander, 2005). Customer goals may include things such as ease of customization, budget, security or even happiness of the people delivering the product. Business and organizational goals may include, for example, increasing profit or market share, defeating competition, gaining more users or optimizing use of resources, or, in case of non-profit businesses, things such as educating the public or covering running expenses. Technical goals usually address the ease, or sometimes limits, of software creation. (Cooper et al., 2014)

Nonuser and user goals may interact differently with each other. Achieving one goal may make it easier or more difficult to reach another goal (Alexander, 2005). For example, sometimes nonuser goals may induce maintenance, scalability or extensibility issues, solving which, unfortunately, might result in stretching the user goals. Nonuser goals need to be addressed, but not at the expense of user goals. Nonuser goals do not drive the basis of design and should serve user and business goals – users do not generally care

about technology if their goals are properly addressed (Cooper et al., 2014). In some cases, it may be beneficial to create personas to represent this kind of goals (Cooper et al., 2014).

To better understand where the goals emerge from, let us next look to what mental models are, and how they relate to implementation models.

2.1.3 Implementation models and mental models

Technologically difficult systems and phenomena are explained through *conceptual models* (Norman, 1988), also known as *mental models* (Cooper et al., 2014). People do not need to know the details of complex systems, but instead they create a cognitive shorthand, a mental model, for explaining system in their point of view (Norman, 2002). An example of a mental model could be how a person models a lock in a door. The person knows that turning specific key in the lock base opens the lock, and that other keys do not. In users mind the key turns some lever out of the way so the latch may open.

On the other hand, *system model* (Norman, 2004) or *implementation model* (Cooper et al., 2014) of the lock describes in detail how the lock mechanism works. While every lock works the same way in the persons mental model, the implementation model may significantly vary between different lock types. The implementation model contains precise information about the inner mechanisms of the lock, for example, pin chambers, key pins and levers, that react in specific way to the inserted key (Ollam, 2012). There might even be electrics in the door, creating a log entry to separate database every time the door is opened; the user may be completely unaware of this kind of things, since this has nothing to do with the user's mental model of lock opening the door.

In software industry mental and implementation models are unfortunately often close to one another, since developers see the product and activities in different manner than ordinary people (Holtzblatt & Beyer, 2016). From developer's point of view, it makes sense to reflect the infrastructure of the implementation model to the user interface, that is, to provide different buttons for different functions or input fields for every data input. The drawback is that most users are not interested on how the software works beneath the surface, but what it does, since understanding the how is usually not helping on using the

product (Cooper et al., 2014). Furthermore, humans do not think like computers; representing the system through implementation model without taking the user's mental model into account often leads to poor usability (Norman, 2002).

Design model (Norman, 2002) or *represented model* (Cooper et al., 2014) stands between mental and implementation model, as depicted in Figure 1. Represented model is perhaps at its most evident form in software industry, where technology allows developers to completely hide the implementation model.

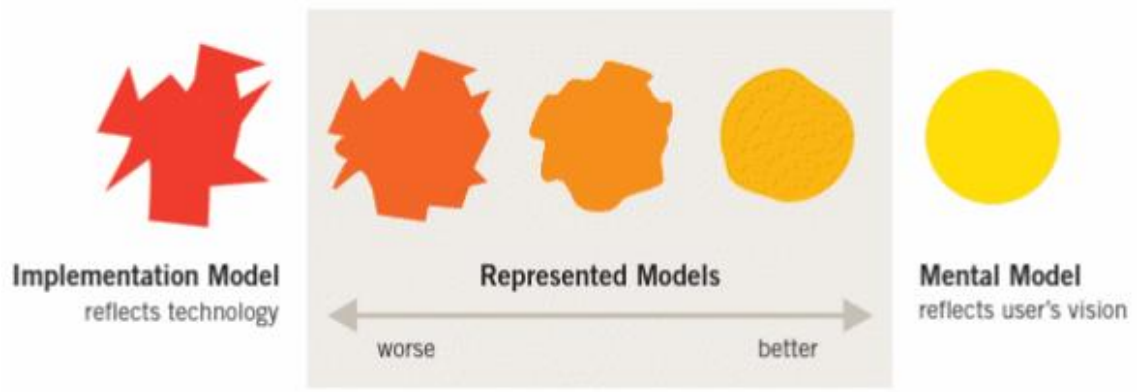

Figure 1: comparison of implementation and mental models (Cooper et al., 2014, p. 19).

Represented models are for good, since they allow us to forget the technology and focus to the task at hand. The closer the represented model is to the user's mental model, the easier it is for the user to understand and use the application, while coming closer to the implementation model generally makes usage more difficult. (Cooper et al., 2014)

When the represented model is close to the mental model, the software also often eliminates needless complexity from the UI (Cooper et al., 2014). As an example, when writing this thesis, automatic save was toggled on – a click of a button, and Microsoft Word automatically saved the file to Microsoft OneCloud under my account. In the background the software is monitoring every change, sending the changes over the internet, authorizing requests, the data eventually ending up to some data center, possibly located hundreds of kilometres away. My mental model of saving a file to cloud is quite far from the implementation model, but it is perfectly fine. It is enough for me to know if my changes are saved in the cloud, which Word expresses through small *Saving…* or *Saved* text in the

header bar, successfully eliminating the visibility of all the non-relevant background work, that is going on.

Now that we have a better understanding of goal-directed design, user goals and mental models they emerge from, it is time to have a look on how to gather data from the users.

2.2 Contextual inquiry

One of the preferred and vastly used (Wixon et al., 2002) methods for gathering user data in user-centered design is called *Contextual Inquiry*. Contextual Inquiry is part of well documented (Beyer & Holtzblatt, 1995; Holtzblatt & Beyer, 1997) larger scheme, *Contextual Design* (Holtzblatt & Beyer, 2016), which is a complete front-end design process. It includes techniques for analysing and presenting user data, ideating and designing product solutions based on the data and iterating solutions with users.

Contextual Design consists of three phases, of which the first one is gathering the data with Contextual inquiry. The design team gets to know individual users through visiting the field and doing contextual interviews in the field. The data gathered from the field is then interpreted using models to gain a big picture of the whole market. The second phase uses the gained knowledge for ideating and inventing new product concepts based on the user data, and in third phase the concepts are designed thoroughly, including user interfaces and behaviour. The third phase ends with validating and iterating the design with users. (Holtzblatt & Beyer, 2016)

Contextual inquiry was first invented in 1988 (Whiteside et al., 1988), and it has been revised in 2013 to account for newer technology, namely smart phones and laptops, but it has remained the same at the core, emphasizing contextual interviews happening while user is working at natural working environment. (Holtzblatt & Beyer, 2016)

The suggested relationship model for contextual interviews proposed by Contextual inquiry is master-apprentice model, where researcher acts as apprentice and is trying to learn from the master, acted by the user. In this kind of model, the users, who often are not natural teachers merely practice their craft, creating an attitude of inquiry on the researcher's side and an attitude of sharing on the user's side. (Holtzblatt & Beyer, 2016)

However, the master-apprentice model benefits from some adaptation for research purposes, since researchers are not learning about work in order to do it, but to create something to support the work (Holtzblatt & Beyer, 2016). The four basic principles of Contextual inquiry guide the adaptation of master-apprentice model to better suit research, and are as follows (Holtzblatt & Beyer, 2016):

1. *Context*, which is the most basic requirement of Contextual inquiry. The principle encourages researcher to step into the user's world, to go wherever the user is and observe what they are doing while they are doing it. This allows the researcher not only to see how the environment supports the task, but also discover why things are done the way they are. What caused user to switch from task to another? Was it a colleague asking for help or a sticky note hanging from monitor reminding to finish another urgent task? Boredom or difficulty to finish current task? Moreover, seeing the activity happen allows the researcher to see the little details instead of the user summarizing the activity, and it brings concretion to tasks the user completes. Being present also uncovers emotions the user is experiencing when doing tasks, which brings background to something that makes the user strongly pleased. Probing on these emotions may raise important user goals.
2. *Partnership* aims to create collaboration between researcher and user, where both influence the exploration. The exploration alternates between observing the work and discussing about interesting details, as well as asking for quick feedback when design ideas start to emerge. It is important to avoid other relationship models, such as expert-novice model, where the researcher becomes a helping hand for the user.
3. *Interpretation* drives design decisions, but interpretations must always be backed with facts. The researcher observes the facts, and makes a hypothesis, an initial interpretation, which is confirmed with the user. The researcher should share and confirm interpretations, as it does not risk biasing the data – it is difficult to get the user to agree to a wrong interpretation. It is instead important, that the researcher avoids assumptions based on their own interpretations. Thus, gathering the user data is as simple as it first seems; the data does not just lie somewhere waiting to be picked, but researcher must carefully collect relevant facts without forgetting the meaning behind them.

4. *Focus* reminds the researcher to stay on the subject and guide the conversation to the details necessary for solving the design problem at hand. In the master-apprentice model the master decides what is important for the apprentice to learn but the principle of focus gives the researcher a way to steer the conversation to things that are meaningful for the design. The researcher should still commit to challenging made assumptions instead of trying to validate them.

The four principles of Contextual inquiry guide the interview and help the researcher to collect relevant data. In addition, the design problem at hand and the activity under study constrain which method should be used, but the most common structure for Contextual Inquiry is contextual interview (Holtzblatt & Beyer, 2016). Contextual interview is suitable for almost any kind of project, and it consists of four parts, presented in Figure 2 (Holtzblatt & Beyer, 2016).

Figure 2: contextual interview structure, as proposed by (Holtzblatt & Beyer, 2016).

The first part, getting an overview, serves as introduction between the researcher and the user, as well as introducing the project and focus, and perhaps getting a short summary of the related opinions and activities from the user. (Holtzblatt & Beyer, 2016)

The second part, transition, moves the focus from traditional interview to setting rules for contextual interview. While being short, this part is important, as this is the part where the researcher takes the role of apprentice. It is also important to mention, that if the user does not wish to be interrupted, they can tell the researcher to hold off for a moment and return later to the event. (Holtzblatt & Beyer, 2016)

The third part is the actual inquiry, where the researcher follows the user, takes notes and possibly guides the user to follow the focus, and the researcher and user co-interpret the behaviours suggested by the researcher. It should be acknowledged that even interruptions, such as unexpected phone calls are data. (Holtzblatt & Beyer, 2016)

The last part, wrap-up, is summarizing and concluding the interview as well as providing a final opportunity to correct and elaborate the interpretations. The summary should not repeat verbatim what happened during the interview but raise the most important patterns observed throughout the interview. (Holtzblatt & Beyer, 2016)

Originally Contextual inquiry assumed two to three-hour contextual interviews with users (Holtzblatt & Beyer, 1997), but has been shortened to 90 minutes to two hours in the updated edition (Holtzblatt & Beyer, 2016). It is also easier to find diverse set of users willing to consent for interviews when they are shorter (Cooper et al., 2014).

Even as short as one-hour interviews can be long enough though, if interviewees are carefully selected. Cooper and others (2014) suggest creating a *persona hypothesis* to aid in identifying candidates. This hypothesis serves as a starting point when selecting users for interviews, and should be based on likely behaviour patterns, which may be analysed from information gathered from stakeholders, SMEs or even literature review. The hypothesis attempts to address three questions to differentiate users: firstly, what different sorts of people might use this product, secondly, how their needs and behaviours may vary, and finally, what ranges of behaviour and types of environments need to be explored. (Cooper et al., 2014)

Cooper and others also suggest other improvements: while the core principle of Contextual Design, *Design for life*, (Holtzblatt & Beyer, 2016) is close to what Cooper and others aim for with users' goals, Cooper and others emphasize identifying user's goals over the more task-focused approach of Contextual Design. It should be acknowledged though, that asking the user's goals directly leads often into inaccurate or even dishonest answer, and thus goals should instead be interpreted by the researcher (Cooper et al., 2014).

Similarly, another principle of Contextual Design, *Design in teams* (Holtzblatt & Beyer, 2016), is endorsed by Cooper and others, but they recommend using smaller design teams. While Contextual Design assumes a large design team conducting multiple interviews in parallel, small teams of two to three persons benefit from entire team having interviewed all users directly, leading to more effective analyzation of the gathered data (Cooper et al., 2014).

The contextual interviews might produce considerable amount of user data, which is not yet in very usable form when making design decisions, especially in agile development

(Fox et al., 2008). Let us next have a look at how the data can be condensed to more usable form.

2.3 Introducing personas

Creating models of users help us to condense the user data and creating an abstraction, while preserving the important parts of the data. User models are called personas (Cooper et al., 2014).

A persona is not just a description of a real person, but a composite archetype based on in-context observations of multiple users representing the same user group. Personas express the users' goals, motivations and related environments through a concise model. (Cooper et al., 2014)

While being simple as a concept, they require finesse when applied. Creating personas is not gathering stereotypes and generalizing or coming up with personas based only on instinct (Pruitt & Adlin, 2006; Cooper et al., 2014) . For personas to be effective tools for design, the significant and meaningful patterns in user behaviour must be carefully analysed, so they can be turned to archetypes that represent a cross-section of a user group (Pruitt & Adlin, 2006; Cooper et al., 2014). If given time and precision in constructing, personas really become to life, starting to resemble real people, similarly to characters in television series (Grudin & Pruitt, 2002). Depending on the data available and the amount of effort, the time to create a persona may vary from days to months (Pruitt & Adlin, 2006).

Personas have various benefits, but essentially, they guide product design to be more user-centered. Personas define the users, highlighting the real person that is using the system (Pruitt & Adlin, 2006), and help in clearing vague assumptions about users (Pruitt & Adlin, 2006), thus reducing the elasticity of the user (Cooper et al., 2014) – oftentimes when users are not properly known, every person in the product team has different opinions about the user, which leads to an *elastic user* that fits conveniently to anything the product team offers instead of representing the real users' opinions (Cooper et al., 2014). Furthermore, personas make the users' goals and needs explicit, further guiding decision-making (Long, 2009).

Personas also tackle self-referential design, where the goals designed for are not users' goals, but the product team's goals (Cooper et al., 2014). This kind of products might be cool but might lack the functionality to serve the user goals or follow implementation model too closely and are thus difficult for users to understand (Cooper et al., 2014). Personas also help in prioritizing product requirements, challenging assumptions and promoting innovations (Miaskiewicz & Kozar, 2011).

Given the benefits, personas surely seem an attractive tool for design, but there is also criticism towards personas and related risks. Perhaps the biggest criticism towards personas is that they are just made up, but nothing could be further from the truth. Correctly constructed personas are always based on research data, and every major trait of a persona should be traceable back to user interviews (Pruitt & Adlin, 2006; Cooper et al., 2014). It is also argued that involving individual users in design cycle, a methodology known as *participatory design* (Schuler et al., 1993) would surpass personas since real users are involved. Personas, on the other hand allow analysing the behaviours of a broader set of users and conceptualizing these behaviour models to a single persona, while focusing on individual user makes it more likely to miss common behaviours in user group the selected individual just does not do – or does differently than most users (Cooper et al., 2014).

Furthermore, it should be acknowledged that personas are generally product-specific and should not be reused without taking care (Grudin & Pruitt, 2002; Cooper et al., 2014). The temptation to overuse personas should also be considered, as personas should augment and enhance existing design processes and user focus, not replace them completely (Grudin & Pruitt, 2002).

Before digging into the how personas are constructed, let us first have a look at different types of personas.

2.3.1 Persona types

Primary personas are the main target of interface design, and each interface can have only one primary persona assigned, although complex products may contain distinct interfaces targeted for different primary personas. Primary persona will not be satisfied, if

the design is targeted to any other persona, but other personas will not, at least, be dissatisfied by design targeted to primary persona. If there is difficulty in selecting primary persona for interface, the product might need multiple interfaces for different primary personas, or the scope of the product is too broad. (Cooper et al., 2014)

Secondary personas are mostly satisfied by primary persona's interface but have additional needs that can be fulfilled without putting the primary personas needs to risk. There may not be any secondary personas assigned, but similarly to difficulty in selecting primary personas, if there are several secondary personas, the scope of the product may be too broad. (Cooper et al., 2014)

Supplemental personas' needs are combinations of primary and secondary personas' needs and are satisfied with design for primary personas. Unlike primary and secondary personas, there can be any number of supplemental personas related to an interface. (Cooper et al., 2014)

Customer personas address the customers', not the users' needs, satisfying the non-user goals discussed in Subsection 2.1.2. Customer personas are often treated like secondary personas but may also be primary personas for specific administrative interfaces. (Cooper et al., 2014)

Served personas are not users of the product themselves but are affected by use of the product (Cooper et al., 2014). For example, a customer in a store could be a served persona for the system used by cashier, as the cashier relies on the system for communicating product prices for the customer. If it is difficult for the cashier to see the individual prices, a customer asking for them is likely to be unsatisfied. Similarly, customer personas are typically treated as secondary personas, as served personas are. (Cooper et al., 2014)

Finally, *negative personas* or *anti-personas* communicate things that the product is not built for. This type of personas may represent for example criminals or tech-savvy users, and their sole purpose is to communicate that the design target should not be like these personas. (Cooper et al., 2014)

The research phase exposes the users' behaviour patterns – these represent goals and motivations and drive the creation of personas (Cooper et al., 2014). We'll have a closer look of constructing personas in practice in the next section.

2.3.2 Constructing Personas

For constructing personas, there are multiple suggested ways, such as (Pruitt & Adlin, 2006; Baxley, 2002). This thesis follows Cooper and others' (2014) method for construction, presented by a standardized process of eight steps, presented in Figure 3. The process assumes user research is done prior to starting the construction.

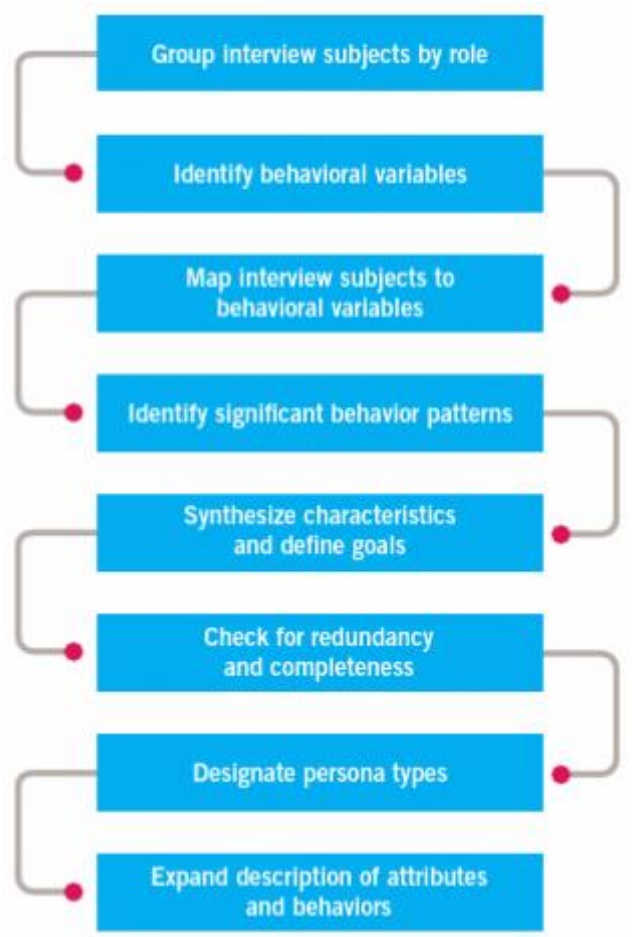

Figure 3: constructing personas (Cooper et al., 2014, p. 82).

The first step assumes prior research on the organization to assign interviewees to groups by their roles in the organization. Generally, in enterprise applications roles map to job roles or descriptions. (Cooper et al., 2014)

In the second step the observed *behavioural variables* found from role groups are identified. Cooper and others (2014) suggest focusing further on user's activities, attitudes, aptitudes, motivations and skills to find important distinctions between them. The found variables can be compared to initial persona hypotheses, possibly revealing new roles or

behaviours that were not expected, that may lead to need for additional interviews to fill the gaps (Cooper et al., 2014). An example of behavioural variable could be technical skills, representing how good technical skills the interviewee has in relation to other interviewees.

Third step uses the sets of behavioural variables and maps each interviewee to each identified variable. Some of the variables present a continuous range, such as technical skills, as presented in Figure 4. In continuous range variables the placement of interviewees in relationship to each other should be considered more important than the precise positioning. This is because there might not even be a way to measure something precisely, so it is more important to distinct how the interviewees differ from each other. In addition to continuous range variables there can also be variables that represent discrete set of choices, such as preference to use keyboard over mouse or mouse over keyboard. (Cooper et al., 2014)

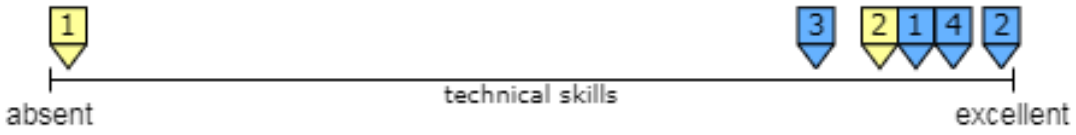

Figure 4: example of behavioural variable (technical skills) representing continuous range in this study—the relationship between the interviewees is more important than precise positioning. The yellow pointers represent interviewed carriers and blue pointers represent interviewed scale operators and the numbers in pointers differentiate interviewees.

In the fourth step the significant *behaviour patterns* found when a set of users form clusters across multiple behavioural variables are identified. Generally, users who map similarly in six to eight variables are likely to represent a significant behaviour pattern. These behaviour patterns form the basis of personas, and typically two or even three patterns can be found for each role. One should be careful when finding patterns, since combining variables such as *technical skills* and *prefers using keyboard over mouse* may be logical and imply causality but combining *is vegetarian* and *prefers using keyboard over mouse*

is deceptive, as it does most likely not contain any logical relationship between the two variables. (Cooper et al., 2014)

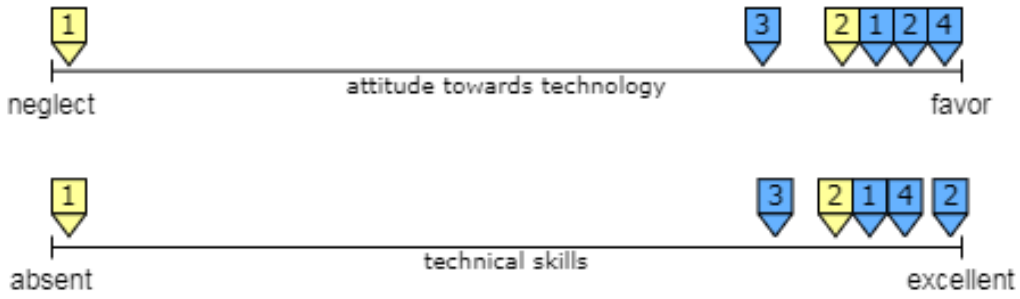

Figure 5: Example of connection between two behavioural variables from this study. It is logical to imply that *technical skills* relate to *attitude towards technology*, as the interviewees map similarly in both behavioural variables. A behavioural pattern is found, if multiple behavioural variables can be combined this way. The yellow pointers represent interviewed carriers and blue pointers represent interviewed scale operators and the numbers in pointers differentiate interviewees.

The fifth step in creating personas is synthesizing goals and details for found behaviour patterns. The details should represent "a meaningful, typical use of the product over a time that adequately captures the relevant set of user actions" (Cooper et al., 2014, p. 85), and are derived from the observed behaviours in the research process. At this point the synthesized data should include:

- The behaviours themselves (activities and the motivations behind them)
- The use environment(s)
- Frustrations and pain points related to the behavior using current solutions
- Demographics associated with the behavior
- Skills, experience, or abilities relating to the behavior
- Relevant interactions with other people, products or services
- Alternate or competing ways of doing the same thing, especially analog techniques (Cooper et al., 2014, p. 85)

In addition to these details, the most critical detail, goals, should also be synthesized. The behaviours and details start to infer to goals that lead to the identified behaviour. Goals should always relate to the product at hand, and they are best derived from observing actions and analysing interview. Persona goals focus on end goals, as personas typically have zero to one life goals, zero to two experience goals and three to five end goals. Cooper and others also emphasize adding the personas' first and last name at this point of creation, and even some demographic information such as age and job title, as these help in visualizing the persona better when assembling behavioural details. However, redundant fictional biography and quirky details make personas distracting, so one should keep the data concrete. (Cooper et al., 2014)

At the sixth step of creation the personas have started to become to life, and the step focuses on checking the completeness and redundancy of the personas. It should be checked if some behaviours are missing or if any additional research should be conducted. If any two personas have very similar goals and differ otherwise only slightly, these redundant personas could be removed at this phase, or characteristics could be tweaked to make the two personas more distinct. (Cooper et al., 2014)

The seventh step prioritizes the now more people-like personas. This is crucial part of the design, since trying to serve the needs of multiple users at the same time can be very difficult. Prioritizing means selecting a single persona, whose goals can be completely fulfilled by single interface in a way, that does not leave other personas out of the scope. Cooper and others (2014) assign personas with *persona types* discussed in Subsection 2.3.1.

The eighth step concludes persona creation by expanding the description, attributes and behaviours through creating third-person narrative about the personas' significant behaviour patterns. The third person narrative has very powerful way of communicating the personas attitudes and needs to others (Cooper et al., 2014). As the personas become familiar, they start to resemble real persons similarly to characters in tv series (Grudin & Pruitt, 2002).

Nevertheless, even at the final step no redundant data and no behaviour that was not observed should be added. While the narrative by nature contains some fictional situations, it should not be a short story, and the details should be traceable to user data. The persona should also not describe ready design solutions, but rather the pain points of the persona.

A photo of the persona should also be added at this point, and it preferably should hint demographics and environment of the user in a natural manner, further bringing life to the persona. (Cooper et al., 2014)

At this point the personas should resemble real persons. To further add depth to the personas, they are combined with scenarios, which bring the actions of personas to life.

2.4 Persona based scenarios

Cooper and others (2014) combine the concept of personas with another concept by Carroll (2000), scenarios, that model people and their activities in the form of stories. In software development, scenarios are used to document activities to support reasoning in specific situations, and to foresee the situations and possible problems related to them even before they are created (Carroll, 2000).

Instead of providing a set of requirements, a set of features or an abstracted goal, scenarios present a tangible, concrete vision of a product (Carroll, 2000), allowing more precise decision making but keeping options open (Rosson & Carroll, 2002). When focusing on the goals pursued in the scenario, meaningful interactions with the system can be captured, promoting innovative ideating, but allowing evaluation of the usability of design proposals at the same time (Rosson & Carroll, 2002). Still, being intentionally incomplete, scenarios remain flexible, making it easy to rewrite parts or to elaborate them (Carroll, 2000). Overspecification of scenarios is even considered as a potential pitfall (Simpson, 1992).

Scenarios include *actors* to represent persons and *objectives* as results pursued. Each scenario has at least one actor and one objective, but it is typical to have multiple actors and objectives. Furthermore, scenarios propose a *setting*, the environment and circumstances, in which the actor of the story operates to reach the objectives. The plot and progress of the story is described through *actions* and *events*; something the actors do, something that happens to them, changing circumstances and so forth. (Carroll, 2000)

Carroll (2000), uses abstracted, role-oriented models as actors which puts the focus into the goal of the *scenario* instead of the goal of the *user*. This leads into elaborating tasks without acknowledging the user goals and the motivation behind them, making the product definition misguided. The missing part of Carroll's scenarios is the use of personas in

place of actors. Representing user through a persona as actor of the scenario brings tangibility to the actor, enabling the exploration of user motivations and help broadening the scope of the scenario. (Cooper et al., 2014)

With persona-based scenarios, we have a very distinct but concise base of knowledge about the users and their environments for making design decisions and to build software upon. This kind of scenarios allow design stories to describe an ideal experience from the user perspective, rather than technology or business perspective, and thus answer questions such as *What should the product do?* and *What should this product look like?* instead of *How the system responds to the user?*. This way persona-based scenarios help in gathering the requirements needed for designing the product. (Cooper et al., 2014)

2.4.1 Constructing scenarios

Before jumping to creating scenarios, some supporting work should be done. Cooper and others (2014) suggest at first creating problem and vision statements to support and guide the design and to keep focus. The problem statement is defining why design is needed in the first place, while the vision statement inverts the problem statement, becoming a high-level design objective that is led by users' needs (Cooper et al., 2014).

Cooper and others also suggest, that at this point the team gathers to explore and brainstorm, putting early design ideas in store for later. This is helpful in preventing preconceptions affecting the future design and promoting fresh ideating based on research results. (Cooper et al., 2014)

Finally, it is important to identify persona expectations though personas and research data to understand the personas' mental model (Cooper et al., 2014). Understanding the mental model is an important part, since, as discussed in Subsection 2.1.3, design should reflect the mental model, not implementation model. Identifying persona expectations is a step we might revise later, when the scenarios start to form.

After the background work is done, it is time to create the scenarios themselves. *Context scenarios* address personas' goals to gain a broad view of the personas' life and activities performed in story-like way (Cooper et al., 2014). Context scenarios establish the primary touch points with the product for each primary and secondary persona, without addressing

any interfaces or technologies at specific (Cooper et al., 2014). If there are multiple primary personas related to the product, it is typical that there are many context scenarios, though even one persona may require more than one context scenario (Cooper et al., 2014). Context scenarios resemble Carroll's (Rosson & Carroll, 2002) activity scenarios, the main difference being that Cooper and others' context scenarios put more focus on the personas and goals, while Carroll's activity scenarios focus more on the critical functionality of the product.

Context scenarios are the first but the most important type of scenarios, as other types of scenarios, presented in next section, elaborate on them (Rosson & Carroll, 2002) (Cooper et al., 2014). The context scenarios aim to present the ideal interactions with the system and can be analysed together with carefully created personas to gather design requirements (Cooper et al., 2014). The collected requirements can then be used to compare the current product functionalities with the ideal functionalities (Cooper et al., 2014). As context scenarios present the ideal interactions with the product, it is natural that they should be entirely textual, since the way to accomplish the goal may not yet exist in the product (Cooper et al., 2014).

Context scenarios give the initial stories of user using the future product in meaningful way. The design may begin with context scenarios but should still be supplemented with other kinds of scenarios in later phases.

2.5 Evaluating design

By analysing the interactions of primary persona in each scenario, parts of high usage, *hot spots*, can be identified (Aoyama, 2007). These hot spots represent new requirements. In Cooper and others' (2014) first step of designing the product based on personas and scenarios, the context scenarios are analysed to extract design requirements, dividing to data, functional and contextual requirements.

Data requirements represent information that is necessary to present to user, such as address. *Functional requirements* are performed actions, typically representing interface controls and their places. Finally, *contextual requirements* consider physical environment, but also describe possible real-world relationships between different data require-

ments. In addition to these, there might be other requirements to consider, such as business, customer or technical requirements, such as working environment or technologies at use. (Cooper et al., 2014)

At this point Cooper and others (2014) suggest defining the interaction framework better through defining form factor, posture, functional elements, data elements, as well as functional groups and hierarchy and sketching interfaces for the first time. As Wasteado is an existing system that has an interaction framework in place, these steps are skipped in this thesis in favour of improving the existing design over creating completely new design.

The second step elaborates the context scenarios with the design requirements to create *key path scenarios*. Key path scenarios describe the most significant user interactions with the product in more detail, focusing to fulfilling previously extracted functional and data requirements (Cooper et al., 2014). While key path scenarios are naturally task-oriented when describing the details of interaction with the product, user goals should not be forgotten, but used to trim unnecessary tasks (Cooper et al., 2014). Key path scenarios follow the structure of Rosson's and Carroll's (2002) information scenarios, but also combine elements from interaction scenarios.

Finally, the third step in designing with scenarios is validating designs through *validation scenarios*. These scenarios are less detailed and cover actions that users rarely take but must be able to perform, as well as alternative, less significant use cases and edge cases (Cooper et al., 2014).

As mentioned in the previous section, the design may, and should, to some extent, begin with the context scenarios. The key path scenarios and validation scenarios are adding depth into the context scenarios, and often the details start to form only after the design work has begun. (Cooper et al., 2014)

Before starting the design, let us summarise the methods.

2.6 Summary

When evaluating user experience, it is critical to know your users. The introduced methods are among the most common methods when collecting user data (Wixon et al., 2002), and provide a base for conducting this study, which aims to improve the usability of

Wasteado by making design more user-centered. The study can be summarized into four steps.

Firstly, data of users is gathered via contextual inquiries. Contextual inquiries are considered effective, since they combine interviews with observation (Holtzblatt & Beyer, 2016). The method puts the interviewer into the work environment of the interviewee and establishes a setting where the focus is on the work yet gives the interviewer a possibility to observe the actions and surrounding environments (Holtzblatt & Beyer, 2016).

Secondly, the user data is analysed to create fictional, but data driven personas, that represent users. The personas are tools for design and a way to communicate what kind of users are using the product and require comprehensive knowledge of the users (Grudin & Pruitt, 2002; Pruitt & Adlin, 2006; Cooper et al., 2014), which contextual inquiry supports with interviews and observation. When correctly constructed, personas are effective at defining the users, which helps to aim the design for the users—if the users are not known, the design target may be wrong (Pruitt & Adlin, 2006; Cooper et al., 2014).

Thirdly, scenarios, which supplement personas with stories of the activities performed by them are created. Scenarios are essential parts of personas, as they present the ideal interactions between the persona and the product (Cooper et al., 2014). Similarly, personas can be seen as essential parts of scenarios—without the motivations and goals of the main actor the stories presented in scenarios seem vague (Grudin & Pruitt, 2002; Cooper et al., 2014). When used together, personas and scenarios can describe the users and their actions and environments vividly, and thus are powerful tools for design (Grudin & Pruitt, 2002).

Finally, the design requirements can be extracted from the scenarios by analysing the interactions of the persona and finding parts of high usage, hot spots (Aoyama, 2007; Cooper et al., 2014). These design requirements can be used to evaluate how the current design responds to ideal interactions, and thus improve the existing design.

3 User analysis

This section discusses why and how the user analysis was planned and conducted and discusses the results and potential pitfalls.

3.1 Overview of the study

The goal of the thesis is to gather information about the users of Wasteado to understand how the system is used, and to use this knowledge to improve the usability of the system. Moreover, the data is gathered into personas and scenarios so it is in a format that can later be used to justify design decisions. Personas also bring tangibility to users and scenarios bring tangibility to the use cases of personas, which further tackles tacit knowledge, since the whole team has access to user data.

Wasteado is a diverse and expandable enterprise resource planning (ERP) system developed for the needs of waste management companies. It features digital shipping documents, which are required when moving cargo from one place to another, such as moving garbage to waste centres. Furthermore, Wasteado features weighing functions, inventory management and reporting which are necessary for operating waste centre.

The study is conducted using contextual inquiry, presented in Section 2.2, as method to gather the data of users. The gathered data is analysed and personas, presented in Section 2.3, are formed based on the analysis of the data. Prior to conducting the interviews, persona hypotheses are created to help in finding suitable interviewees, but also to find out if there are any prejudices in order to be aware of them when conducting the interviews.

After personas are created, they are further analysed to create persona-based-scenarios depicting essential use cases, presented in Section 2.4. Finally, by analysing the personas and scenarios together and comparing them to the current state of the system, potential pitfalls of the system may be found.

3.2 Persona hypotheses

As Wasteado is a business product having user and role management, the roles in the system serve as a good base for persona hypotheses (Cooper et al., 2014). Based on the

current roles of the system, the main users of the system, and thus user groups personas could be created of, are as follows:

- System admins, responsible for general system upkeeping.
- Office workers, handle waste centre relations towards clients.
- Client representatives, handle client relations towards waste centres.
- Machine operators, responsible for moving material inside waste centre.
- Scale operators, handle shipping documents as staff on waste centres, for example ones created by carriers. Also responsible for inspection of the documents.
- Carriers, responsible for collecting material and transporting it to waste centres. Creating shipping documents for collected cargo.

Due to the large user base of Wasteado, as well as the lack of previous user research, the nature of the thesis is more of scratching the surface than conducting a full user analysis. Thus, of these roles, scale operators and carriers were evaluated to be the most significant types of users and were selected for further analysis at this point. The selected roles also act together in the system, carriers creating documents in the system, which are later handled by scale operators, so evaluating the use cases together should prove to be insightful. Also, as Wasteado has many users across Finland, it is to be expected, that there are many personas inside both roles.

Furthermore, it was decided that interviewees will be selected only from one region in Finland to keep the scope of this thesis reasonable—the responsibilities of the roles may differ slightly between different regions and companies. Should the results provide the need to explore these roles further in other regions, it will be done as separate research.

Based on current information, gathered from various sources, such as previous field visits, the product owner of Wasteado, SMEs and representatives of the selected roles, that have been interviewed in other occasions, the following four persona hypotheses were made.

3.2.1 Scale operator 1

Elderly male persona resisting digitalization. This persona does not want things to change and is used to doing things his own way. New systems are observed to restrict work and make it slower, and thus the persona is not fond of taking new systems into use and reacts

sceptically to them. The persona is reluctant to do any excess work in the system and easily gives up in case something is not working as intended. Regardless of the reluctance in using digital systems, the persona is recognized to be precise in his job and to share an interest in good customer service.

3.2.2 Scale operator 2

A younger persona more open to new systems. This persona is more used to digital systems in his/her daily life, and thus is not drawn back by small adversities. The persona might notice if the system is working wrong and can find ways to work around the problem. The issues are often not brought up though, even when having the possibility, since most used workarounds have already become a part of daily work. The persona shares the interest in good customer service with the first persona hypothesis and is willing to take the extra mile to make the customer's day.

Alongside the interest for good customer service, several types of behaviour should be paid attention to when conducting the interviews for both scale operator personas. Firstly, as part of the customer service experience, the communication with the customer, as well as the surrounding environment, such as devices used in communication should be further explored. Secondly, it should be examined if the scale operator has visual contact with the customer and what information is needed from the customer in order to proceed in tasks. Thirdly, it should be analysed if the scale operators need more than one system or other supporting elements to perform their common tasks, and finally, it should be perceived how the personas operate under busy hours.

3.2.3 Carrier 1

The first carrier persona resembles the first scale operator persona in terms of demographics and resisting digitalization. The persona is somewhat separated from the digital world altogether, smartphones and laptops being far from the persona's world, as well as using email; persona might even not have an email account. When having the need to carry out a task using software, the persona oftentimes needs assistance in doing so. Even after being assisted a few times, the persona might not be capable of carrying out even the simplest of tasks in software on his own.

3.2.4 Carrier 2

The second carrier persona is a younger male. While not having the most fluent technical skills, the persona is able to handle moderately difficult tasks in software and does generally not resist using digital devices and software. Nevertheless, the persona does not like interruptions in work caused by bugs in software and does not try workarounds, instead giving straightforward feedback about bugs and difficult to use functionalities in the system.

For both carrier personas, attitude towards technology was considered a trait to be followed. It should also be studied whether if the personas have multiple systems they use and what kind of devices the personas use with each system.

As driving is a crucial part of the work of these personas, it should be explored if systems are in use when driving and how the personas use them while driving. Furthermore, as carriers are moving between different locations, it should be explored how the work is supervised and how the machinery, connections and possibly different disruptions caused by them affect using the systems.

3.3 Conducting interviews

After the initial hypotheses were set, it was time to find interviewees. As the scope was decided to be limited to a single region, I reached out to a representative of our client and received the contact details for two scale operators and three carriers.

The interviews were conducted successfully with all five participants in May-June of 2022. As the scale operators work in pairs, a little bit longer interviews of one and a half hour were reserved for them, as in the observation part of the interview there was essentially two persons to observe and interview—essentially there was seven participants in total, four scale operators and three carriers.

The interviews consisted of brief introduction to the study and the contextual interview method, and the permission to audit the interview to support memory in later analysis was requested at this point. After the introduction the interviews followed the structure of

contextual interview, as depicted in Figure 2, starting with the interview part, transitioning to observation, conducting the observation part and finally a brief concluding part. The interviews lasted mostly a bit over an hour with the carriers and one and half an hour to almost two hours with the scale operators—I did not rush the observation part to a closure, as some of the interviewees seemed natural and continued to share interesting data.

As Wasteado was in use for Finnish speaking personnel during the thesis, all interviews were conducted in Finnish. Outline for discussion and privacy policy forms used in interviews can be found from Appendices A and B respectively. Note that the privacy policy form is also in Finnish, due to the participants being Finnish.

The next section presents the further analysis of the data—creating the personas and scenarios.

4 Creating personas and scenarios

This section introduces the creation of personas and scenarios based on the user data collected with contextual interviews.

4.1 Personas

In the previous section the first scale operator hypothesis and both carrier hypotheses presented in Section 3.2 were confirmed strong enough for further evaluation, so these hypotheses serve as initial groups inside the roles for the first step of persona creation, Group interview subjects by role (Cooper et al., 2014). The outline for persona creation steps can be found in Figure 3.

For the second step, the behavioural variables are identified from the interviews. This is done by listing the distinct aspects of observed behaviour of each role (Cooper et al., 2014). The identified behavioural variables are as follows:

- demographics
    - age
    - gender
    - education level
- activities: actions performed in the system
    - frequency of creating new documents in system
    - frequency of finding/editing old documents in system
    - frequency of communicating with other users (of the system)
- attitudes: opinions of something
    - attitude towards technology
- aptitudes: tendency to do something; natural skills
    - initiative to open job description
    - ability to learn new software without support
    - ability to find solutions with trial and error
- motivations: what is driving the interviewees
    - interest in environmental issues
- skills: what are the interviewees good at, or what skill they are lacking

- domain expertise
- customer service expertise (relevant for scale operators only)
- technical skills
- communication skills
- ability to work independently
- ability to combine knowledge from multiple sources
- ability to work under pressure / in rush hours

As was expected based on the interviews, the interviewees grouped similarly in the behavioural variable mapping. The full behavioural variable mapping can be found from Appendix C. All four scale operator interviewees mapped similarly in most of the variables, but in few variables, such as *domain expertise* and *ability to work independently*, there seemed to be two distinct groups of two interviewees. This could mean, if researched further, that there could potentially be two slightly different personas, but on the other hand the similarities in most other variables indicate that one persona would suffice.

Interestingly, two of the interviewed carriers mapped similarly to interviewed scale operators in several behavioural variables. This could mean that a single, perhaps a bit less distinct persona could represent both roles, but since the roles are very different in terms of activities performed in the system, this kind of persona would not make much sense.

For the scale operator persona, the significant behaviour patterns and characteristics related to them would seem to be as follows: firstly, all four interviewees were able to combine knowledge from multiple sources, which leads into strong domain expertise in waste management domain. The need to combine knowledge comes from the job itself, as there are many sources where information must be obtained from in order to perform. Furthermore, the field is constantly changing, so there is always more to learn. The motivation for learning actively seems to raise from interest in environmental issues, as the field is both environmentally and civically important. Secondly, the strong domain expertise combined with strong technical skills, openness and good communication skills lead to scale operators being fluent in customer service. This seems to raise from the motivation to be good at one's work as well as sharing their domain expertise and knowledge to customers to help them.

The use environment for the scale operators was normal workstation with mouse and keyboard, several screens, some of them showing camera feed from the scale where trucks drive and few for the use of Wasteado, email and other related software. The users were mostly satisfied with Wasteado, but the frustrations that were observed in the interviews were mostly related to how some of the simple functions took many steps to accomplish. These issues related to the seventh usability heuristic, flexibility and efficiency of use (Nielsen, 1994a).

Similarly, two carrier interviewees representing the second carrier hypothesis, carriers two and three in the mapping, mapped akin in most of the behavioural variables. Carrier interviewee one, representing the first carrier hypothesis, was clearly separate from the two in most of the variables but mapped similarly in activities and some of the skills, such as ability to work independently—this seems to further imply, that there are different types of people doing the same job, which leads into separate personas. It should still be acknowledged that the number of participants is limited in this study.

The major behaviour patterns that all three carrier interviewees characterized are diligence and willingness for independent work, but differences in technical skills and motivations separate carriers to two personas. The use environment for all the carriers was also similar, as all of them had a truck, which had a tablet for the use of the system. Some of the interviewees also had other systems in parallel use, and they preferred using Wasteado with smartphone instead of the tablet. The interviews did not reveal any major pain points for the carriers, but the carriers had lots of data visible, which was not relevant for their job.

The motivation for the perceived behaviour for the first carrier persona can be driven from the interest in environmental and civic issues: the interviewees representing the first carrier persona were both conscious that their job is civically important, which seemed to lead them to be diligent in their jobs. The diligence was further supported by their good technical skills and domain expertise. The interviewees also raised the ability to plan one's work themselves important, which would seem to be a motivation for the willingness for independent work. For the first carrier persona, the demographics also seem meaningful, as the interviewees that represented the persona were young and had some education.

The second carrier persona, representing the second hypothesis, would also seem to drive the motivation for the behaviour from diligence, but would seem to view work generally as matter of diligence, rather than raising motivation for the diligence from the civic importance of the job. The motivation for the diligence would thus seem to raise from simply being diligent by nature and the will to be good at one's job. When looking at the demographics, this persona would seem to be older and have only little education, which could also affect the willingness to change job, which could further lead to being diligent.

Summary for the persona characteristics can be found from Table 1. Further data, such as goals, small descriptions and names for the personas that were created in persona creation steps five and six can be found from the personas in Appendices D, E and F. The scale operator persona is referred as *Sara Mäkelä* from here on and the first carrier persona is referred as *Elias Mattila* from here on. The provisional persona for the second carrier hypothesis is referred as *Seppo*—last name being omitted to create distinction, that the persona is not fully fleshed with real data but is partly based on assumptions.

Persona	**Persona hypothesis**	**Major characteristic**	**Motivation**
Sara Mäkelä	Scale operator 2	Strong domain expertise	Interest to environmental issues
		Strong customer service skills	Sharing environmental knowledge
		Ability to learn and combine knowledge from many sources	Constant changes in domain; Interest to environmental issues
Elias Mattila	Carrier 2	Diligence	Civic importance of the job
		Willingness for independent work	Will to affect one's work
Seppo (provisional persona)	Carrier 1	Diligence	Personal trait

Table 1: summary of persona characteristics and motivations.

The seventh step in persona creation, designating persona types, is rather simple, as the personas already have distinct views. Sara Mäkelä is the primary persona for the weighing interface and shipping document interface in Wasteado. Elias Mattila and Seppo act as customer personas for the weighing interface, but have their own interface for shipping documents, for which Elias is the primary persona and Seppo acts as secondary persona.

The eighth and final step in persona creation, expanding personas with narrative, can be found from Appendices D, E and F. At this point also stock photos were added for Sara and Elias—a photo was not added for Seppo, to further indicate that he is a provisional persona.

4.2 Scenarios

This section introduces scenarios, constructed following Cooper and others' (2014) method, presented in Subsection 2.4.1. For the first step, vision and problem statements were created to guide design. As Wasteado is an existing system, the problem and vision statements were formed to firstly guide improvements for current design without the need to recreate all views, but also to guide design of new views. The problem and vision statements can be found from Appendix G.

The second step, brainstorming to exhaust early design ideas, was briefly done between me and the product owner of Wasteado when going through the ready-made improvements and bugs that were found during the interviews, and formed ideas were collected to the same list. Instead of having a full workshop to exhaust ideas, brainstorming was only done briefly at this point as the scenarios are quite broad in the scope of the thesis—it is likely that the personas and scenarios will be supplemented later with further research, which may affect the design.

In the third step, the observed behaviours, the attitudes and expectations were analysed to identify persona expectations. The resulted expectations are weaved into the personas themselves, found in Appendices D, E and F. Some of the persona expectations can also be found from the following context scenarios.

The results of the fourth step, creating context scenarios for each persona and identifying hot spots that represent design requirements, can be found from the Appendix H, along with the design requirements extracted from the context scenarios (the fifth step). The

context scenarios were created by describing a typical workday of a persona in such detail, that the environments and basic activities can be found from the scenario, but without relating the activities to Wasteado yet. For example, the context scenario for Sara contains handling shipping documents in office environment where she often gets interrupted, but it does not mention the precise actions she does in the system.

Each of the personas have their own context scenario, resulting in total three context scenarios. The design requirements were extracted from the scenarios by analysing what the persona expects from the system—for example, how it should behave in situations represented in the scenario or what units of data should be visible.

The context scenarios were supplemented by creating key path scenarios based on the context scenarios and design requirements and can be found from Appendix I. The key path scenarios were also kept at relatively high level in the scope of the thesis. A total of seven key path scenarios were created, Sara having four scenarios, Elias having a single scenario, and Seppo having two scenarios. Sara has more scenarios than Elias or Seppo, as her work has the most variability and different use cases.

4.3 Results

The study proved contextual interviews can be used to gather the data from users via interviews. The interviews yielded very useful data, which deepened the knowledge about scale operators and carriers and how they operate daily. The data was good enough to create two personas and a provisional persona, three context scenarios and seven key path scenarios.

Personas are great at bringing tangibility to users and make the needs of users explicit, reducing assumptions when designing. Similarly, scenarios are great at making use-cases and user activities come to life and promote the most important activities in daily work—this vastly helps to bring focus into main activities and leaving edge-cases to less attention. Both personas and scenarios are easy to understand and more importantly, they are easy to elaborate on later. It is also easy to justify design decisions that are based on a need of a persona or create a feature that fulfils a real-life scenario.

But perhaps the most important result of the thesis is that the personas, scenarios and design requirements are recorded now. The development team has access to them, and

that they can be elaborated when knowledge grows. Tacit knowledge of users and use-cases can be written into personas and scenarios, making knowledge available for everyone. Should the development team change, the new members have access to the same information, and can refer to it when making design decisions.

4.4 Discussion

Methods

The research methodology chosen for this study, contextual inquiry, worked rather well despite me doing the interviews and observation alone. Using a team of two to three persons to conduct interview and observe activity could lead into observing more things, which could further lead into more accurate persona, but I think a team can also impact the interviews and observation negatively. I recorded audio of the interview part, but aside from writing notes I mostly did not record anything in the observation part. The interviewees seemed tensed in the interviews and became much more receptive after the recording had stopped, and it was much easier to understand the personality and motives of the interviewee.

On the other hand, using a team in the interview could also ease up the tension, as one of the team members would act as interviewer, while the others stay silent and only take notes. This way the recording could be avoided, or it could be more discreet, as the interviewee could focus on what the interviewer is asking. It should also be acknowledged, that using a team to validate the personas at some point is important to avoid bias.

Interviews and personas

In addition to collected user data, the interviews also yielded some ready-made improvement ideas and some minor issues. These were discussed, briefly refined and collected to product backlog for further actions. The further refinement together with the analysis of the data might affect how, and if, the improvements should be implemented in the first place.

Of the scale operators, all four interviewees represented the second scale operator hypothesis, so at this point the hypothesis could be confirmed, and further evaluation done based on the data, potentially leading to a persona. Although none of the participants portrayed the first hypothesis, it should not be discarded at this point, as the scope of the research

was limited. To discard it completely, further research reaching larger user base should be conducted. Also, as the behavioural mapping showed, there could be room to separate Sara into two more distinct personas, as some of the interviewees mapped similarly enough to fit into single persona, but still seemed to form their own group.

The interviewed carriers characterized both carrier hypotheses, one of the interviewees portraying the first hypothesis, and two of the carriers portraying the second hypothesis. It should be acknowledged, that the number of interviewees, as well as the scope where interviewees were selected were limited, and thus the interviews of the carriers alone should not be considered enough to confirm or discard the carrier hypotheses. Together with the data from scale operator interviews, both the hypotheses seem to be plausible, but it seems—as was expected in the hypothesis—that most of the carriers representing the first persona do not even use Wasteado, but rather conduct their affairs using pen and paper, and are thus not eager to participate in interviews regarding Wasteado.

Furthermore, it is difficult to reach this kind of carriers, since—as was expected in the hypothesis—the carriers may not even have a phone number they could be reached from. Further research would be required to fully confirm (or decline) the carrier hypotheses, but together with the data gathered from scale operator interviews, both the carrier hypotheses were considered strong enough for further evaluation after the interviews, although the persona for the first persona hypothesis is created with the distinction that it is *provisional* (Cooper et al., 2014), meaning it is partly based on assumptions and data from other sources than the persons characterizing the persona.

Scenarios

The key path scenarios, especially for Sara, were chopped down into smaller use cases, so multiple key path scenarios were formed. There could, and probably in the future will, be even more key path scenarios that are further supplemented with validation scenarios, but it is not reasonable to create these in the scope of this thesis. The possible later research should also take the existing scenarios into account, as it seems likely, that in the scope of this thesis some use cases are left off. It is of course natural, that as knowledge of the users grows, the scenarios should be revised and elaborated, and more scenarios should be created.

The identified hot spots in the scenarios did not raise any new major design requirements or present a need for major new features—Wasteado currently seems to have most of the

features. As Wasteado is in production use, it was expected that the basic uses are satisfied, but even the minor findings can provide major improvements in the daily use. Moreover, the hot spots provide a good support for future development and guide developers to enhance the current design to be more usable.

Summary

The study deepened the knowledge about the end users, clarified their roles, activities and interactions between other users through interviews, and gathered the data to usable format as personas and scenarios. The interviews also exposed that there may be types of users, that differ in terms of activities and personality from the ones that were anticipated, which justifies additional research. The personas and scenarios proved to be a potent way of describing users and their activities. The narrative style used in personas and scenarios highlights the users' goals, but it is also giving visibility for the development team to the surrounding environment, relations, other users and everything else that is happening around. The personas and scenarios also bring tangibility to how the system is used daily, and make the most used cases emphasized, putting focus on things that matter the most. These things vastly help the development team to understand the reasons and motivations behind the users' actions, leading the design to serve the user better.

5 Conclusion

5.1 Summary of the study

The goal of the thesis was to gather information about the users of Wasteado to understand how the system is used, and to use this knowledge to improve the usability of the system. Furthermore, the gathered knowledge was to be recorder in a format where the whole development team can use it to justify design decisions and to tackle tacit knowledge.

The study was conducted using contextual inquiry, presented in Section 2.2, as method to gather the data of users. Prior to conducting the interviews, persona hypotheses were created to help in finding suitable interviewees, but also to find out if there are any prejudices in order to be aware of them when conducting the interviews.

The gathered data was analysed, and two personas were formed based on the analysis of the data. The personas can be found from Appendices D and E. In addition, a provisional persona was created and can be found from Appendix F. The provisional persona requires further studies to be fully confirmed, but the results of this study show that it is likely this kind of persona exists. The story of personas was supplemented with persona-based-scenarios, presented in Section 2.4. The initial context scenarios and the design requirements extracted from them can be found from Appendix H. The context scenarios were supplemented with more distinct key path scenarios, which can be found from Appendix I. Finally, the collected data, personas, scenarios and extracted design requirements together can be used to compare the current state of the system to the ideal state and find improvements.

The study deepened the knowledge about the end users, clarified their roles, activities and interactions between other users. Contextual inquiry seems to be a useful method when collecting qualitative data from a small group of interviewees. The personas and scenarios proved to be a potent way of describing users and their activities. The narrative style used in personas and scenarios highlights the users' goals, but it is also giving visibility for the development team to the surrounding environment, relations, other users and everything else that is happening around. The personas and scenarios also bring tangibility to how the system is used daily, and make the most used cases emphasized, putting focus on things that matter the most. These things vastly help the development team to understand the reasons and motivations behind the users' actions, leading the design to serve the user better.

5.2 Limitations

Due to the large user base of Wasteado, as well as the lack of previous user research, the nature of the thesis was more of scratching the surface than conducting a full user analysis. Thus, only two of all the roles in the system, scale operators and carriers, were selected into the analysis. Furthermore, it was decided that interviewees will be selected only from a single region to keep the scope of this thesis reasonable.

I conducted interviews alone instead of the recommended team of two to three persons, but as mentioned in the discussion in Section 4.3, I think this did not impact the quality of the interviews.

Also, the scenarios were kept at high level, as it is to be expected that there will be more scenarios should further research be conducted. This is, if the further study would reveal more personas in the same roles, these scenarios could include some of the same elements that is in the scenarios created in this study. Also, the scenarios created for other roles that were not included in this study can affect the scenarios presented in this study.

5.3 Recommendations for further study

When conducting further research, the research methods should be considered to take interviewees into account, as it might be difficult to find participants for long interviews like in this study. In longer interviews, such as in this study, disruptions in work or interview were inevitable, since driving a waste truck in the narrow streets of city requires the carrier's full attention, and the work requires jumping in and out of the truck, which means breaks in the interview. My suggestion for this would be to shorten the interview from a full hour to 10-30 minutes and conduct it while the interviewees can fully focus on the interview, for example when the carriers are driving into waste centres to unload cargo. The shorter interview would be less disruptive and easier to attend to for the interviewees, which would hopefully increase the number of participants. These matters could also have reduced willingness to participate to interviews in this study.

Of course, the shorter interview time requires that there is plenty of willing participants, so the data quality comes through quantity. If the number of participants is small, I too

recommend the longer interview time, as this increases the quality of the data from a single participant.

The study also revealed that there might be even more personas for carriers, that might resemble Elias or Seppo in terms of personality but differentiate in activities performed in the system—both Elias and Seppo have very distinct use cases, and the use of Wasteado is very simple for them. This should also be considered in possible later research.

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Appendix A – bullet points for contextual inquiry

Introduction

- Why am I here?
    - Thesis; aim to improve usability by getting to know users
    - Privacy policy; asking for permission to audit discussion
    - Short walkthrough of the interview process
- Personal questions:
    - What lead you to work on waste management domain?
    - Shortly describe the purpose of your job (without referring to the product)
    - Shortly describe your typical day at work
    - What motivates you in your work?
    - How would you describe yourself as a user of technology?
        - (tech savvy – not technical at all)
- Product related questions:
    - Why do you use the system?

Transition

- Transition to master-apprentice model
- I'll follow what you do, but think-aloud if possible
- If you do not wish to be interrupted, please let me know

Observation

- Show & tell
- What parts are the most critical for you?
- Are there things you cannot do with the system?
- What do you like the most in the system?
- Has the system improved your daily work (compared to previous system), and if so, then how?
- Were there parts that were better in the previous system?
- Could the system somehow help you better in your daily work?

Wrap up

- Short summary of the interview. Validating interpretations
- Any questions?
- Thank you for your time!

Appendix B – Permission to audit conversations in interviews

Tietosuojailmoitus käytettävyystutkimuksen haastattelua varten

Pyydän sinua osallistumaan haastatteluun osana käytettävyystutkimusta. Haastattelu ja sen tulosten analysointi on osa pro gradu -tutkielmaa.

Tutkielmassa henkilötietojasi käsitellään suostumuksesi perusteella. Voit koska tahansa peruuttaa suostumuksesi. Henkilötietojasi ei käytetä automaattiseen päätöksentekoon tai profilointiin. Henkilötietojen antamiseen ei ole lakiin tai sopimukseen perustuvaa velvollisuutta. Tutkimukseen osallistuminen ja tietojen luovutus sitä varten on täysin vapaaehtoista. Henkilötietojasi ei luovuteta ulkopuolisille, eikä niitä näin ollen myöskään siirretä EU-ETA:n ulkopuolelle. Henkilötietoja sisältävää aineistoa käsittelevät vain tutkielman tekijä ja tarvittaessa hänen ohjaajansa.

Henkilötietojasi käsitellään vain niin kauan kuin tutkielma on saatu valmiiksi. Tutkielman valmistuttua henkilötietoja sisältävät aineistot poistetaan. Käytettävyystutkimuksen tulokset raportoidaan siten, ettei niistä voi tunnistaa yksittäistä osallistujaa. Tulokset toimitetaan järjestelmän kehitystiimille ja niitä käytetään palvelun kehittämiseen. Osallistujien henkilötietoja ei luovuteta eteenpäin.

Henkilötietojesi käsittelyn ajan sinulla on rekisteröitynä seuraavia tietosuojalainsäädäntöön kuuluvia oikeuksia, joista tutkimuksen yhteydessä voidaan poiketa vain lainsäädännön mukaisesti:

- Oikeus saada pääsy tietoihin
- Oikeus saada virheelliset tiedot oikaistua
- Oikeus tietojen poistamiseen ("oikeus tulla unohdetuksi") tietyissä tilanteissa
- Oikeus käsittelyn rajoittamiseen tietyissä tilanteissa
- Oikeus käsittelyn vastustamiseen tietyissä tilanteissa
- Oikeus tehdä valitus valvontaviranomaiselle: tietosuoja.fi, puh: 0295666700, sähköposti: *tietosuoja@om.fi*

Yhteystiedot:

Tutkielman tekijä: Severi Ollikainen, <*contact_details*>

Tutkielman ohjaaja: Zheying Zhang, <*contact_details*>, Informaatioteknologian ja viestinnän tiedekunta | Tietotekniikka

Appendix C – Behavioural variable mapping

The contents of this appendix contain business information of the product under inspection in this study and are not disclosed.

Appendix D – scale operator persona: Sara Mäkelä

The contents of this appendix contain business information of the product under inspection in this study and are not disclosed.

Appendix E – carrier persona 1: Elias Mattila

The contents of this appendix contain business information of the product under inspection in this study and are not disclosed.

Appendix F – carrier persona 2: Seppo

The contents of this appendix contain business information of the product under inspection in this study and are not disclosed.

Appendix G – Problem and vision statements

The contents of this appendix contain business information of the product under inspection in this study and are not disclosed.

Appendix H – Context scenarios

The contents of this appendix contain business information of the product under inspection in this study and are not disclosed.

Appendix I – Key path scenarios

The contents of this appendix contain business information of the product under inspection in this study and are not disclosed.