AALBORG UNIVERSITET

SECONDHAND E-COMMERCE HEURISTICS

Master's Thesis – Information Studies

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Abstract

The purpose of this Master thesis was to develop secondhand e-commerce heuristics. This was done by following a methodology proposed by Quiñones et.al. (2018) while using user-centered-design methods. This thesis explored characteristics of secondhand e-commerce and their users and explained the

differences between secondhand e-commerce and generic e-commerce. The results of this thesis are 13 heuristics which can be used for user experience evaluation of secondhand e-commerce. These heuristics were validated through heuristic evaluation method and were proven effective in finding usability issues on secondhand e-commerce platforms. This thesis provides a document with proposed heuristics containing a checklist for each heuristic, which can be used for heuristic evaluation or design suggestions of such platforms.

Introduction

The fashion industry is estimated to be responsible for 8-10% of global co2 emissions, app. 20% of industrial water pollution and app. 35% of oceanic microplastic pollution. Brands produce twice as much clothing as they did before the year 2000. The business model is built on frequent production of trendy and low-cost products which often end up in landfills (Niinimäki et. Al. ,2020). After purchased, the washing and caring of the clothing item continues to have an environmental impact. However, the impact of clothing production is still much greater in comparison (Sohn et. Al., 2021).

Following a circular economy and extending the life of a garment, through such channels as clothes-renting services or secondhand shopping could help to close the loop and decrease the negative impacts of the fashion industry. The energy to gather, sort and re-sell secondhand items requires app. 10-20 times less energy than manufacture of new garments (Niinimäki et. Al. ,2020; Jastram & Schneider, 2018). As customers are becoming more aware of the consequences of their consumption, there is a demand for more sustainable options (Jastram & Schneider, 2018). Sustainable fashion environments created for customers can positively affect their purchase decision as well as raise awareness of buyer's sustainable consumption in young people (Zheng & Chen, 2020).

Over recent years, people started buying more of their items online. Competition in the e-commerce market is growing and it is believed that purchases made through this channel will increase in the near future. With the current growth, it seems that most commerce will be e-commerce by 2050 and this increases the need to study this platform (Laudon & Traver,2017). A survey conducted on 1069 respondents from Central Europe showed that environmental issues are important to the customer when it comes to using an e-commerce solution (Ingaldi & Ulewicz, 2019). However, currently the fashion retailers which make the most revenue in sales include fast-fashion companies such as Zara with 19bn dollars in revenue and Shein with 11bn dollars in revenue, who are not environmentally friendly. (Peters, 2021). There are other causes that affect the growth of many e-commerce businesses. Global pandemic Covid-19 caused digital transformation of many retail businesses. Due to lockdown, people were not able to shop for some goods in person. Already in the first year of pandemic, global retail trade went from 14% in 2019 to about 17% in 2020 (UNCTAD,2021).

Also, secondhand and vintage stores had to adapt by going online. But with these types of items there is extra work required when turning offline shops into e-commerce, because the items are often missing labels and extra information, with many items being unique and there is usually just one of each item (Tucker, 2021). Also in secondhand shopping, the typical definition of a seller and a buyer cannot be well defined, as well as the pricing of items needs to be adjusted due to uniqueness of the items and traditional regulations and designs used for conventional fashion e-commerce businesses are not applicable to alternative channels such as secondhand buying (Jastram & Schneider, 2018; Visconti et.

Al., 2013). These differences and a special type of customer that secondhand addresses need to be considered when designing a secondhand e-commerce.

Problem description and research questions

Secondhand items are usually different to new items because there is a need for extra information and the roles of buyers and sellers can be reversed (as previously mentioned), which is different from typical e-commerce platforms (Visconti et. Al., 2013). Therefore, there are more things to consider when focusing on user experience of secondhand e-commerce and there is currently no tool to evaluate this user experience.

A study by Baymard Institute (2022) has shown that abandonment cart rate in e-commerce is currently at 68.8% and suggests that by improving user experience of e-commerce conversion rate can increase by at least 35%. One way to increase user experience of e-commerce solutions is to perform heuristic evaluation, to uncover usability issues, which need to be fixed.

Heuristic evaluation is a method to evaluate user experience (UX) in general, when it comes to chosen application domain, and is less specific than user testing (Tan et. Al. 2009). Usability heuristics are rules of thumb used to evaluate and design a better user experience of an application (Nielsen, 2006).

There is, however, still a lack of heuristics in UX field and with the web becoming more complex, there is a need for updated tools (Roto et.al., 2009). Especially when it comes to such platforms as e-commerce, there is limited research regarding usability evaluation methods (Gonzalez-Holland et. Al, 2017). And since secondhand e-commerce is an even more specific domain type, there is a need for heuristics which could be used to evaluate the user experience of this platform and improve the platform and motivate people to shop secondhand online. The goal of this report is to produce a set of heuristics which could be used for designing and evaluating user experience of secondhand e-commerce. Therefore, my research question is as follows:

RQ: How do heuristics that evaluate user experience of secondhand e-commerce look like?

This question is further subdivided into the following research questions:

RQ1: Do current e-commerce heuristics successfully cover all features of secondhand e-commerce?

RQ2: What are secondhand e-commerce heuristics and are they successful at discovering usability flaws in e-commerce?

RQ3: What are the differences between secondhand e-commerce heuristic and generic e-commerce heuristics?

Related work

When conducting any kind of research, it is important to familiarize ourselves and build upon existing knowledge within the subject area. This is where a literature review comes into place. A literature review analyzes and organizes information from relevant studies (Rowley & Slack, 2013). The direction of literature search should be based on the research question (Bryman2012).

There are different ways of gathering relevant literature. One way to gather literature is to perform a systematic literature review which follows explicit steps to avoid any possible biases. It is a replicable, scientific, and transparent way of reviewing existing research and literature (Bryman,2012).

Another way is a traditional or narrative literature review, which is a great way to collect large quantities of literature in a specific area, summarizing and synthetizing them. The criteria for selecting literature in this type of literature review are not as strict as with different types, such as systematic literature review (Cronin et. Al., 2008). The purpose of narrative literature review is to gather initial information about the topic, which is more explored in the research. It is less focused and bigger in scope than systematic literature (Bryman,2012). Literature review was an important part of this project, as gathering information about the chosen application domain of this research – secondhand e-commerce, is the first and very crucial step of the chosen methodology. I decided to implement narrative literature review, as my purpose was to gather as much information as possible about the domain, features, and heuristics in general.

Literature search strategy

There are different channels to search for this literature. Some of them are libraries, search engines or online databases (Rowley & Slack, 2013). The databases I used to search for literature were Scopus, Primo and Google Scholar. I used building blocks strategy to select search topics and phrases. This strategy starts with the initial search concepts and extends them by using synonyms and related terms (Rowley & Slack, 2013).

Since this Master thesis topic revolves around designing heuristics for an online secondhand e-commerce, search topics were divided into two concepts: secondhand shopping and e-commerce.

When investigating e-commerce my focus was on e-commerce user experience, user-centered e-commerce, e-commerce heuristics, e-commerce design and e-commerce website evaluation. However, many search results in these areas were not relevant enough. The search terms, both basic and advanced, which brought valuable results were: **"e-commerce user experience", "e-commerce website evaluation", designing AND e-commerce AND for AND user, user-centered AND e-commerce**.

When investigating secondhand shopping, my focus was on topics regarding sustainable shopping, sustainable fashion, secondhand shopping and online secondhand. Since sustainability includes many aspects, only the following search terms brought relevant results: **“sustainable fashion", "secondhand shopping”, "online secondhand".**

To evaluate the relevancy of search results, the PQRS method was used. This method is described as preview, question, read and summarize. It allows for easy retrieval and identification of literature, especially when dealing with large numbers of publications (Cronin et. Al., 2008).This method was especially suitable due to many irrelevant results being returned in searches and made it easier to select the ones which suited the topic.

The related work gathered for this report was used in two different ways. Topics regarding e-commerce user experience were described in the following paragraphs, however, the sources describing e-

commerce heuristics and secondhand e-commerce platform were also used in the Exploratory stage of the methodology.

I reviewed secondhand e-commerce, to understand the platform and their users, topics about what makes e-commerce successful to understand what affects the success of such solution, and e-commerce usability and heuristics to get acquainted with the existing research, regarding ways of improving the usability of a solution and heuristics used for evaluating the user experience quality of e-commerce.

Literature used in this Master Thesis was approved by the supervisor(See Appendix 1, image1).

Secondhand e-commerce

Since this Master Thesis focuses on designing heuristics for secondhand e-commerce, it is important to understand what secondhand means, what kind of items it includes and how it can be classified within e-commerce sector.

The issue of fashion practices affecting the environment and the demand for different sustainable channels were mentioned in the introduction. One of the solutions to these issues is to use sustainable fashion sources. Sustainable fashion items can be divided into eight different channels: Recycled, Organic, Vintage, Vegan, Artisan, locally made, Custom and Fair trade. However, people tend to perceive mainly Secondhand or Vintage items, Items made from recycled materials and Items labelled as Fair trade and made from Organic Materials to be part of sustainable fashion (Shen et. Al. 2013). From these, secondhand is special because when it comes to Vintage and Secondhand markets, both customers' and retailers' roles can be exchanged. We can divide these markets into 2 categories: direct channels, which includes consumer-to-consumer markets and indirect channels, where a service is provided, through which sellers sell to customers (Visconti et. Al., 2013). Such a service can be an app or a website, providing an e-commerce platform for sellers or a secondhand e-commerce website which receives items from sellers and takes care of the trade.

Electronic commerce, or so-called e-commerce, can be described as purchasing, selling, and exchanging goods and services through the internet (Tharindu et.al, 2021). E-commerce does not include every transaction and process happening online, only the ones happening outside of the company, for transactions within the company a term e-business is used (Laudon & Traver,2017).

Based on which sides are interacting together we distinguish different types of e-commerce. These are business to business, **business to consumer(b2c)**, business to employee, business to government, business to manager, **consumer to consumer(c2c)**, consumer to business, government to business, government to employees, government to government and peer to peer (Nemat, 2011). Based on what is their interaction channel e-commerce is divided into mobile e-commerce, which uses mobile devices to enable transactions, social e-commerce, which is enabled by social networks and online social relationships and local e-commerce which focuses on engaging the customer based on their location (Laudon & Traver,2017).

Most online secondhand e-commerce is either **customer to customer**, where consumers use an online platform to resell goods between each other, or a **business to customer**, where the company obtains secondhand items and sells it to consumers.

When it comes to features and design of e-commerce Kim & Lee (2002) described critical design factors that affect e-commerce quality. These were divided into information related to product, information related to browsing, search related information, structure complexity, consistency, search convenience, browsing convenience, presentation consistency and presentation variety. Fang & Salvendy (2003) described design rules or guidelines to follow in user-centered design. These were 29 rules divided into the following categories based on the component: homepage, navigation, categorization, product information, shopping cart, checkout and registration and customer service.

When it comes to secondhand e-commerce users, there are different motivators for people to shop secondhand, among these are economic reasons, recreational motives, finding unique products, getting value for the money, environmental reasons, opportunity to help charity and ethical motives which are fueled by negative opinion towards typical market system, its consumeristic nature and damaging environmental effects (Hur,2020; Guiot & Roux, 2010). Research by Styvén & Mariani (2020) studied motivation of shopping on secondhand C2C e-commerce platforms and discovered that desire to distance oneself from consumers' society plays a significant role on these platforms, while choosing it for environmental and economic reasons. These results came from 412 responses of people who shop at platforms such as Facebook Marketplace, Ebay, Gumtree, Depop and others. A study by Fabien et. Al. (2016) also explored motivators of purchasing secondhand online. These were treasure hunting, nostalgia, social interaction, local aspect, distancing from consumerism. The motivations mentioned were the same as for people shopping secondhand in real life, which proved that channel does not play a role in motivation. Styvén et. al.(2020) divided secondhand shoppers into 4 customer groups: **Price conscious** customers – good price/quality ratio and possibility of saving money, **style and quality conscious** – people who enjoy unique finds, vintage clothing, **environmentally and socially conscious** – people who base their choice upon positive social and environmental effect of secondhand shopping, **brand and self-expressive conscious** – people who enjoy high quality branded items for cheaper price (Hur, 2020). These motivation factors and the type of customer should be considered when designing a secondhand e-commerce.

What makes e-commerce successful

A good platform is necessary to bring more people to purchase secondhand online. For e-commerce to be successful and products to sell, it needs to meet the users' needs. To match user needs in e-commerce solution, these needs need to be incorporated into the design (Mu,2021). This business should possess the following non-technical qualities to create a positive user experience: usefulness, usability, and desirability (Saetang,2017). The success of an e-commerce business greatly depends on the usability of the company's platform. Studies discovered that 83% of people will leave the website if they take too long to find what they need and they might choose a competitor's platform instead (Tharindu et.al, 2021).

E-commerce has unique features which should be considered when working with it. It possesses **ubiquity** as users can access it everywhere at any time and has a **global reach** of customers. It also offers more space for **information richness** than traditional media and **information density**, as users can compare product information easily online. E-commerce also allows for more personalization and

customization than traditional commerce as users can have their profile and personal greetings from the company (Laudon & Traver,2017).

When designing secondhand e-commerce, user experience is an important measure to consider as it can help users choose such a platform and support sustainable fashion channels like secondhand over fashion brands which make new produce. Usability is the key component of good user experience (Ritter & Winterbottom, 2017). The ISO (the International Organization for Standardization) defines usability as "an extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" and user experience as "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" (ISO 9241-210:2019, p.3). A poorly designed product can influence a company's reputation and frustrate users. On the other hand, there are many benefits to incorporating usability into design such as increased productivity of the users, decrease in error making of the users, reduced training and support for the system, improved acceptance of the new system and enhanced reputation for the company that designed the system. (Maguire, 2001) When designing for users, it is important to remember that **usability** is not just one simple attribute, but it is a complex concept of a specific user interface. It is usually connected with these five attributes: **learnability, efficiency, memorability, errors, and perceived user satisfaction**. (Nielsen,1994) To ensure good user satisfaction, an e-commerce platform needs to ensure system quality and information quality. System quality includes website's system attributes, like reliability of a website, navigation efficacy and page layout. Information quality includes website content qualities, like accurate and updated information, relevancy and integrity (Zhou & Zhang,2009).

Cao et. Al. (2005) proposed guidelines for web interface design, based on the expert evaluation model of the information quality of e-commerce websites. These guidelines consisted of 23 qualities divided into 9 categories: multimedia, search, responsiveness, information accuracy, information relevance, empathy, trust, and playfulness.

User experience is a complex term which includes emotions, impressions, user responses and behavior while interacting with the product which all need to be considered. (ISO 9241-210:2019) Implementing user experience into e-commerce business can increase customer retention, customer satisfaction, conversion rates, sales, and others (Sood et. al., 2018).

One way to integrate usability and user experience into an e-commerce is through the use of user-centered design. User-centered design is based on detailed understanding of the users, their environment and their tasks and users need to be involved throughout the development process of the application (Chammas et. al. ,2015). Involving users early in e-commerce design can help define a higher quality user interface which plays a key role in gaining customers' trust and feeling of security when using an e-commerce website. Built trust and security has a positive effect on customers' loyalty and helps build a solid customer base (Mofokeng, 2021). Rattanawicha (2014) measured users' expectations and satisfactions, and the change in their attitudes over time, regarding information quality when it comes to e-commerce websites. This was done using 15 quality attributes which can be divided into 4 major categories: intrinsic quality, context quality, representational quality, and accessibility quality. The study compared user's results from 2011 to results from 2014 and shows that users' expectations towards e-commerce quality get significantly higher over time. E-commerce is a complex tool and there is a need for new usability evaluation methods and tools (Tharindu et.al, 2021). However, sometimes

simply following the user-centered design guidelines is not enough. The involvement of the users needs to be adapted to the context of the application and the project development. The strategy of the process must be designed in consideration of the multiple variables mentioned and with the focus on usability and user experience of the product (Chammas et. al. ,2015). These concerns were considered when choosing a methodology for this Master thesis to ensure the newly developed heuristics would provide a way to increase usability and user experience of secondhand e-commerce.

E-commerce usability & heuristics

There are different ways to evaluate usability and user experience of e-commerce solutions. Some studies used Kano's satisfaction model to evaluate e-commerce experience (Mu,2021; Ingaldi & Ulewicz,2019). This model differentiates 3 types of product requirements: must be requirements, one dimensional requirements and attractive requirements. It offers a structure for a questionnaire which can be used in connection with defined requirements. Here users can select from following answers for each requirement: I like it that way, it must be that way, I am neutral, I can live with it that way and I dislike it that way(Matzler et. Al., 1996).

User experience issues can also be discovered by performing heuristic evaluation or user testing. The difference between the two is that heuristic evaluation focuses on high-level issues regarding the interface, and it is possible to evaluate every feature, while user testing is usually based on scenario, and doesn't address all the features. However, it can get into more detail about the specific feature that the test is performed on than heuristics evaluation (Tan et. Al. 2009). Heuristic evaluation is a method which helps to discover usability flaws in an interface (Nielsen, 2006). It is usually conducted by a group of experts and is part of an iterative design process. During the evaluation, the expert goes through the interface and assesses it against the set of UX principles – so called heuristics (Nielsen, 2006). These heuristics are also called design principles to evaluate user experience (ISO 9241-210:2019). UX field is missing a set of defined UX heuristics for expert evaluation. Each company can set a different UX target for evaluation of their platform (Roto et.al., 2009). Many heuristic evaluations nowadays still use Jakob Nielsen's 10 principles – usability heuristics proposed in 1994. These, apart from being 28 years old, however, do not cover all aspects of specific applications, such as e-commerce (Meiselwitz,2021). And with the web becoming more complex there is a need for updated heuristic tools for evaluating usability of the websites (Gonzalez-Holland et. Al, 2017).

Quiñones et al. (2016) explored how some authors develop heuristics without following a specific methodology. This was done in multiple ways:

- by using a set of existing heuristics to create new ones,
- by identifying usability problems with different methods and then creating a new set of heuristics based on these issues
- by translating design recommendations for uncovered usability problems into new heuristics.

The following are described some authors who approached the act of creating heuristics by building on the set of already existing ones.

Hamid et. Al. (2020) used Nielsen's heuristics for evaluating usability of 20 e-commerce websites. Even though they did not come up with a new set of heuristics, they provided a way of applying Nielsen's heuristics in e-commerce context which are otherwise very general guidelines. They provided 3 design guidelines in the form of questions for each heuristic. Ogonowski (2019) provided a guide on how to use Nielsen's heuristics in e-commerce context. He described 41 guidelines to follow to ensure the application and non-violation of these heuristics and showed an example of how these are implemented in giant e-commerce companies such as Zalando or Asos.

Bonastre & Granollers (2014) created a set of 64 heuristics based on 3 different studies on e-commerce principles and guidelines, that should serve as a tool to evaluate user experience in e-commerce websites. This was written in the form of a checklist for features/qualities of website. Even though these provided an elaborate checklist for e-commerce features, some functionalities of secondhand e-commerce specific to presence of sellers and buyers and their roles are not covered.

These studies did not follow a formal methodology for creating heuristics but used literature review as their main method. Following formal methodology provides a unified way of creating new heuristics, which makes the sources easier to work with and apply in future research (Quiñones et.al , 2018).

Rusu et. Al (2011) proposed a methodology for developing usability heuristics. This methodology includes 6 stages: exploratory stage – for collecting information regarding the specific application and possible existing heuristics, descriptive stage – for emphasizing the most important information from previous stage, correlational stage – for determining characteristics of new heuristics, explicative stage – for writing new heuristics in formal way, validation (experimental) stage – for evaluating new heuristics via different methods and refinement stage – for refining the heuristic based on the gathered data from the previous stage. Quiñones et.al (2018) built upon this methodology and extended it to 8 stages: exploratory stage, experimental stage – for running experiments to gather additional to extend collected information, correlational stage – in this methodology domain specific features are matched with selected heuristics, selection stage –based on previous stage, new heuristics are added or discarded, specification stage – same as explicative stage, validation stage and refinement stage. This methodology extended the previous methodology by one new stage and divided another stage into 2 steps. Díaz et.al. (2017) followed the 6-stage methodology and developed 12 cultural-oriented usability heuristics for e-commerce websites. Bascur et al. (2021) followed this proposed 8 stage methodology by Quiñones et.al.(2018) and went through 3 iterations to create e-commerce specific heuristics. They proposed 11 e-commerce user experience heuristics based on heuristics for transactional websites and culturally oriented heuristics for e-commerce that were evaluated through 3 experiments and showed to be efficient. This proved that the methodology proposed by Quiñones et.al. (2018) is an effective way of creating user experience heuristics. This methodology was chosen for my Master thesis and is described in further detail in the Methodology section.

For the chosen methodology of this Master Thesis, it is important to acknowledge usability and UX attributes of a solution as well as existing heuristics. Usability applies to all aspects of a solution that a user might encounter and interact with (Wilson, 2010).

Bader et.al. (2017) compared 6 different existing heuristics to UX attributes from the User Experience Questionnaire proposed by Schrepp et. al. (2017). The study concluded that most heuristics focus on these UX attributes: attractiveness, perspicuity, efficiency, dependability, stimulation. Morville (2004)

proposed a user experience honeycomb that outlines following aspects of UX : useful, usable, desirable, findable, accessible, credible, valuable.

Sudiana et. al. (2021) conducted a systematic literature review to answer which factors of e-commerce website design provide interesting user experience. Based on 27 sources of literature, they came up with 43 key factors. These were not guidelines or heuristics but more of areas that designers should pay attention to while creating e-commerce solutions. Majid et. al. (2015) identified 5 most mentioned usability principles for responsive e-commerce design: consistency, familiarity, flexibility, feedback and aesthetics. This was done by contextual document analysis of existing usability principles and the content analysis of existing e-commerce solutions which included responsiveness in their design.

Research Theory & Methodology

Philosophy of science

Research paradigm is a theoretical framework that influences the way that knowledge is studied and interpreted while it also sets motivation, purpose, and expectations of the research. (Mackenzie & Knipe, 2006) Since the desired result of this project was to develop secondhand e-commerce heuristics that would be generally applicable, I decided to work under postpositivist/critical realism research paradigm. The knowledge obtained while working under this paradigm is based on the collected data, information and measures completed by participants of objective reality that exists (Creswell, 2003).

To stay objective while developing e-commerce heuristics I decided to choose and follow a methodology by Quiñones et.al (2018), carefully step by step while incorporating human-centered methods where applicable.

The ontology of post-positivism is based on beliefs in the existence of an objective stable reality. However, there will always be some imperfections because of human presence, and it falls under critical realism (Pickard, 2017). This fits the reality of developing new heuristics, as they should be generally applicable rules, however this reality is still affected by the users and their preference.

The epistemology falls under modified dualism/objectivism which aims for objectivity, however, acknowledges that complete independence is not possible (Pickard, 2017). That is why human-centered-design was incorporated into acquiring of knowledge about the heuristics, as they cannot be based independent of the users.

When it comes to methodology, post-positivism usually contains mainly quantitative methods, but it can also include qualitative methods (Pickard, 2017). Quantitative research focuses on data collection, gathering numerical or measurable data, where qualitative research deals with words and meaning (Bryman,2012).

For this study, both quantitative and qualitative research methods were used. Mixed methods research can provide bigger strength of the study than simply using one type of research (Creswell, 2003).

The purpose of post-positivism is to generalize the knowledge (Pickard, 2017). This was also the goal of this Master Thesis, to generalize available knowledge about secondhand e-commerce and e-commerce heuristics to create generally applicable second-hand e-commerce heuristics.

Research Theory

Based on how the theory is handled in research, there exists inductive or deductive approach. The deductive approach starts with a hypothesis that is built on existing theory and usually ends with the implications of the findings. Where inductive approach creates a theory based on the findings and the research conducted (Bryman, 2012). Since this Master thesis does not start with a theory and does not try to confirm existing heuristics but rather creates a new theory, a new set of heuristics, it could be said that it uses an inductive approach. Sometimes inductive approach can still include some elements of deductive approach within it. This can happen when inducted theory is tested by further data collection (Bryman,2012). This also happens in this Master Thesis in the Validation step, where newly proposed heuristics are evaluated through experiment to see whether they are effective or need to be adjusted.

Replicability of the study is the possibility of the study to be replicated (Bryman,2012). To ensure replicability of this study, I followed a methodology proposed by Quiñones et.al (2018) and outlined each human-centered methodology that I used in corresponding stage. Furthermore, I used an interview script and predefined set of questions for the survey which can be used for replication of the study.

The validity of the study is concerned with legitimacy of the conclusions (Bryman,2012). To ensure validity of this research effective methods both quantitative and qualitative were used from user-centered-methodology by Maguire (2001). Using mixed methods to ensure validity of the research is called triangulation. In this scenario biases and weakness impact the research less and produced data is more reliable, precise and specific (Ritter & Winterbottom,2017). The image below shows the inductive approach in this Master Thesis.

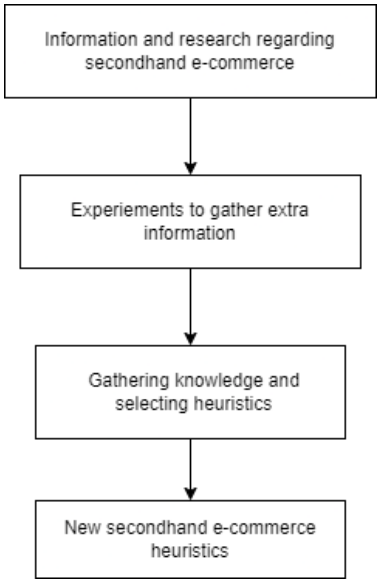


Figure 1 Research theory Master Thesis

Research Methodology

The UX issues of solution can be identified by multiple channels: identifying the stakeholders and their needs, identifying users and their needs, performing competitive analysis, using UX research and similar. Maioli, L. (2018) When choosing methodology for this Master Thesis it was important to incorporate UX research strategies that were relevant to human-centered-design, as the literature stated that user experience is an important part of making e-commerce successful and involving users in e-commerce can make e-commerce more successful. Therefore, it seemed important to include users in the development of the heuristics, as these heuristics are meant to serve as an evaluation tool of an actual e-commerce solution. By implementing user-centered methods, heuristics will better represent users' needs and expectations towards application domain, rather than providing experts' opinions on the platform. Since the goal of this report was to create secondhand e-commerce heuristics, the choice was to use a methodology for developing heuristics in combination with human-centered-design practices for the mentioned reasons.

Heuristics development methodology

Quiñones et.al (2018) proposed a methodology for developing usability heuristics, which consists of 8 steps. Even though the figure shows these steps following each other, in some cases some steps might be optional, or can overlap and be performed together, and the development can be iterated at any step.

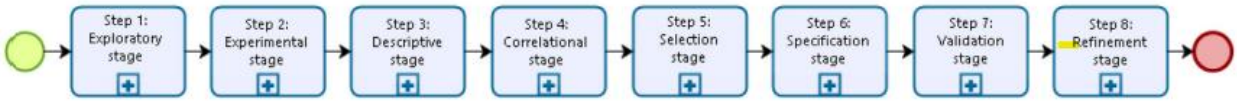


Figure 2 Heuristics development methodology by Quiñones et.al. (2018)

Step1: Exploratory stage

This stage starts with specifying the application domain for which the heuristics should be developed. It follows by collecting information about the application domain, its features, usability and UX attributes and existing heuristics typically based on the literature review (Quiñones et.al, 2018). The base for my exploratory stage was literature review. This is also suggested by the methodology and provided me with the initial knowledge relevant to my research questions.

However, the literature review only provided information about generic e-commerce features and physical secondhand markets. So, to better understand the features of secondhand e-commerce I chose to incorporate competitor analysis. This helped me to see which secondhand e-commerce solutions exist, how they work and what their features are.

I also incorporated stakeholder analysis in the exploratory stage, to know which stakeholders are important and should be focused on in this Master thesis.

Step2: Experimental stage

This stage is for additional experiments that could be performed to obtain extra information which the previous stage did not provide. They should provide information regarding specific features, usability, or current heuristics for the application. Some of the examples used at this stage are heuristics evaluation, usability tests, interview, surveys (Quiñones et.al, 2018).

The competitor analysis only provided limited information about users of secondhand e-commerce.

Therefore, I performed user interviews to understand what users' needs are, their values and preferences when it comes to secondhand e-commerce, which also helped me gather user requirements for the solution.

The demographic information gathered from the interviews served as a base for creating personas. Personas were created as a way of representing obtained knowledge about secondhand e-commerce users and to represent different types of customers.

Step3: Descriptive stage

In this stage the most essential information is selected and prioritized from the information collected in stage one and stage two (Quiñones et.al, 2018). In this stage I prioritized collected information from previous stages as stated in the methodology, apart from the user requirements gathered from the interview.
As they are user requirements, I found it important that the importance of each requirement is evaluated by users of secondhand e-commerce and not just me.

To do this, I created a survey for evaluating the importance of collected features and requirements alongside collecting some basic information about the demographics of participants.

Stage 4: Correlational stage

At this stage, collected features of selected application domain are matched with selected UX/usability attributes and selected heuristics.Each feature should have at least one matching heuristics attribute. (Quiñones et.al, 2018)

For this stage it is important to have selected features for the application and selected heuristics. Sometimes existing heuristics need to be adapted to match the application better. Other times, there are no heuristics which would match specific features. In this case, new heuristics can be proposed at this stage. (Quiñones et.al, 2018) I followed the methodology as stated in this stage.

Stage 5: Selection stage

In this stage, heuristics specified in the previous step are evaluated. A final set of heuristics is proposed (Quiñones et.al, 2018) I followed the methodology as stated in this stage.

Stage 6: Specification stage

In specification stage, the new set of collected heuristics is written in a formal way. (Quiñones et.al, 2018) I followed the methodology as stated in this stage.

Stage 7: Validation stage

In validation stage effectiveness of newly proposed set of heuristic is evaluated through experiments. (Quiñones et.al, 2018) To validate whether proposed heuristics are good or need adjustments I used them to perform heuristic evaluation of a secondhand e-commerce website.

Stage8: Refinement stage

In the last stage of methodology for creating heuristics, proposed heuristics are evaluated based on the information obtained from the previous step. (Quiñones et.al, 2018)

Human-centered design

Human-centered design helps to make interactive solutions more usable and useful for the users. This is done by applying different techniques and methods that are focused around the users and their needs. (ISO 9241-210:2019) Incorporating human-centered design strategies into e-commerce solutions can increase effectiveness, efficiency, user satisfaction and the success of the business. (Sood et. al., 2018) Incorporating human-centered methods can decrease the likelihood of the product being rejected by users or not meeting the stakeholders' expectations. (ISO 9241-210:2019)

Human centered design follows these conventions: it is designed based on the understanding of the users, their environments, and their tasks; it involves users during the design and development, design of the system is fueled by user-based evaluation, the process is iterative, design considers whole experience of the user, and the team should consist people of many different skills and outlooks. (ISO 9241-210:2019)

Since the goal of this Master thesis is not the deign per se, but to create heuristics which could serve as a tool for evaluation of existing solutions, my process does not strictly follow the human-centered design principles and conventions, but rather gets inspired by its ideas and methodologies. This choice was inspired by multiple literature suggesting the need of user involvement in creating e-commerce which I translated into need for user involvement in the creation of e-commerce heuristics.

Maguire (2001) describes the five phases that human-centered-design development should include based on the ISO, as shown on the image below:

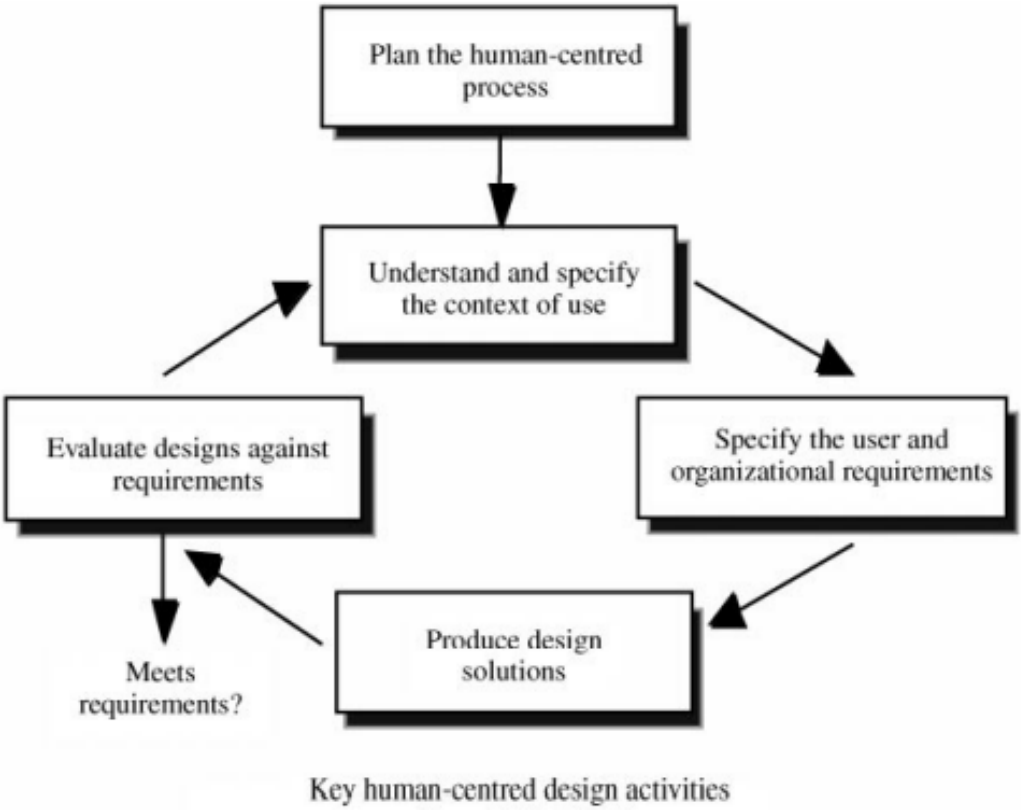


Figure 3 Human-centered design process by Maguire (2001)

Apart from the planning, the rest of the phases can be iterated as needed.

I do not follow these phases, but rather take inspiration from the methods suggested for each phase. To better understand which methods are the most suitable for each of the 8 stages of my methodology, I described the comparison of user-centered phases to methodology of heuristics development stages.

The first step, which attempts to specify the context of use of the solution, defines how the system is used by the users. When it comes to designing e-commerce heuristics, this loosely translates to gathering information about the platform, the features, its users, and general understanding of how the platform works and how people use it. Here, it is also important to identify the stakeholders (Maguire,2001).

When it comes to specifying the requirements, some of the methods that Maguire (2001) suggested were Stakeholder analysis, Competitor analysis, User requirements interviews etc. Stakeholder analysis and competitor analysis was used in Exploratory stage of the methodology, to better understand who is involved and affected by the solution and therefore the heuristics as well as to see which features do competitors have in their solution, that would need to be evaluated. User requirements interviews were used to define the requirements for the solution from a user perspective as they would serve as a base for defining the new heuristics.

Instead of producing design solutions, as that is usually the next step in human-centered-design development, I am producing heuristics. This stage translates to Specification stage in methodology,

where new heuristics are created and specified in a formal way. The last step in human centered design is user centered evaluation of design. One of the methods for this evaluation suggested by Maguire (2001) is heuristic evaluation. This method is used in Validation stage to evaluate the newly made heuristics for secondhand e-commerce.

Implemented methodology

Following is the diagram showing my methodology, which is an implementation of methodology by Quiñones et.al (2018) with inclusion of human-centered design techniques.

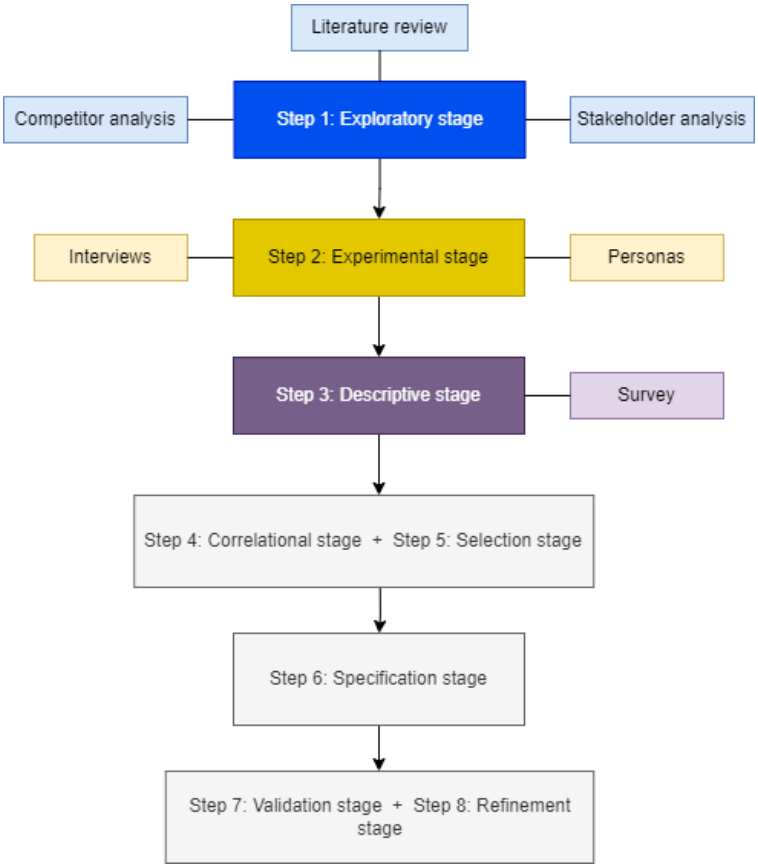


Figure 4 My methodology

Exploratory stage

During the exploratory stage, the chosen application domain should be explored. This means that there is a need to collect information about the application, its definition and features, the UX attributes of the domain and the existing heuristics. (Quiñones et.al. 2018) Extra steps can be taken such as classification of chosen application domain, in case there are multiple types of this domain, domain specific tasks or target audience. (Quiñones & Rusu, 2019)

The need for new heuristics for secondhand e-commerce have been defined in the research problem section. After the domain that needs new heuristics is identified, it is important to gather information which would result in 3 different outputs: (Quiñones & Rusu,2019)

1. Definition of the application and its features
2. usability and UX attributes
3. set of existing heuristics and relevant elements

Definition of the application and its features

To understand secondhand e-commerce applications, I collected information regarding (1) secondhand items, (2) secondhand markets, (3) e-commerce, (4) types of secondhand e-commerce, (5) features of secondhand e-commerce, (6) audience of secondhand e-commerce. These were obtained by literature review (1,2,3), competitor analysis (4,5) and stakeholder analysis (6).

Usability and UX attributes

To understand usability and UX attributes, I researched topics about general usability engineering attributes for software development by Nielsen (1994) and by usability attributes Majid et. Al. (2015), UX attributes by Bader et.al (2017) and by Morville (2004). These attributes are discussed in more detail in the Descriptive stage of the report.

Software & customer specification – Online secondhand definition

Since none of the sources from literature review provided concrete definition of secondhand e-commerce, so I provide a definition based on the combination of e-commerce definition by Laudon & Traver (2017), e-commerce types by Nemat (2011) and secondhand markets definition by Visconti et. Al. (2013) below:

Secondhand e-commerce is a business conducted online where pre-owned goods are exchanged. This is through indirect channel. Based on the type of business, secondhand e-commerce can be customer-to-customer, where a platform is provided for sellers to sell their items and for buyers to purchase these items and potentially contact the seller. In this type of secondhand e-commerce seller and buyer roles are not strictly defined and can be reversed, as sellers can be both sellers and buyers and vice versa.

Another type is a business-to-customer where a platform sells secondhand goods. In this type of business, the goods can either be obtained from people who will afterwards have an overview of their sales but will not be in contact with the buyers and will not have any selling responsibilities or it can be obtained from other sources and just serve as a platform for people to buy secondhand goods.

Competitor analysis was conducted to further define these types of secondhand e-commerce and their features. Stakeholder analysis was conducted to evaluate which stakeholders are important in this research and personas were created to represent the users of secondhand e-commerce and their needs.

Competitor analysis

Competitive analysis can be done at multiple stages of development for multiple reasons: at the beginning, while coming up with requirements; before design – to be used as an inspiration for a prototype and when competitors make changes – to see how it affects users (Goodman et. Al, 2012).

Competitor analysis was an important step in this research to understand the type of platform better and to understand which features secondhand e-commerce provides so. These features would be later discussed in the interview with users and then incorporated into heuristics.

Competitor analysis consists of 4 steps: (Goodman et. Al, 2012)

1. Identifying and describing the competition

2. Selecting key attributes for comparison

3. Comparing competitors to each other

4. Creating suggestions based on comparison

Identifying the competition

An effective way to find competitors is to search online by a few selected keywords. (Goodman et. Al, 2012). Keywords were defined based on my above written definition of secondhand e-commerce. Selected companies were chosen from the results of searches in Google with keywords “online secondhand”, “buy secondhand online", “pre-owned fashion” and in AppStore with keywords “secondhand” and “secondhand fashion”.

Competitors discovered from the searches were prioritized into 3 groups: Tier1, Tier 2 and Niche competitors.

Tier1

For this category, I chose solutions directly relating to secondhand e-commerce business as that is what heuristics are designed for. There can be different types of secondhand e-commerce as already mentioned in the application domain definition: either people selling to other people where the e-commerce is just an online platform for them to use but all the selling process is the responsibility of people, or it can be a company selling the secondhand items for the people, where people either get the discount or money for the percentage of their sales, or it can be a company selling secondhand clothing where they acquired the items themselves from a different source. Some e-commerce companies are offering a service where you can sell your clothes to them and they will sell it for you, however their main focus is still selling new products. For tier1 I decided to choose competitors from c2c category and b2c customer category where user can sell their clothes and where the items are gotten from elsewhere to see how these types differentiate in their functionality.

Selected competitors: Trendsales, Sellpy, Zadaa, VerasVintage, &Lu.

Tier 2

Tier 2 includes companies that are similar solutions as category as Tier 1, but they are not as directly competitive, but still include similar functionalities, or it could be also the companies that are too identical to the ones chosen for Tier 1 analysis. (Goodman et. Al, 2012) For this section 8 companies that are very similar to tier1 were chosen, some of them offering more products than just fashion items and the e-commerce companies that sell also secondhand items and the social platform who offer option to sell items. There was no analysis conducted on these competitors.

Selected competitors: Zalando – preowned, Nakd - secondhand, Facebook Matkerplace, Depop, Poshmark, ThredUp, DBA, Tise, SassyLab.

Niche competitors

These competitors might offer similar solutions and still be a competition on a market, but they are not directly related. (Goodman et. Al, 2012). For this category I chose 4 companies who are still in the business of secondhand fashion, but instead of proving a platform where you can buy and sell your items, they provide a service where you can choose secondhand items and rent them instead.

Niche competitors: Nuuly, HurrCollective, KaloKopenhagen, RentTheRunway.

Tier 1 Competition profile

After the main closest competitors are defined in Tier 1 it is important to describe them in terms of their product and their target audience. Product description should not be longer than a paragraph and should focus on the value it brings to customers. Audience profile should focus on what kind of people us this product.(Goodman et. Al, 2012)

Table 1 Competitor profile

Name	Product description	Audience profile
&Lu https://andlu.dk/	&Lu is an online secondhand shop Denmark which offers clothing shoes and accessories for men and women. This website is an online platform for a physical secondhand located in Herning, Denmark	Men and women who shop Secondhand clothing, located in Denmark. Also, customers of the physical shop in Herning, who like to support the brand, only have time to shop online.
Veras https://verasvintage.dk/	VerasVintage is an online store that sells secondhand women items as well as upcycled secondhand items. Customers can send their clothes to this shop, where they will either get sold or upcycled and sold. Customers recieve points for sale for which they can shop on the website.	Women who are interested in vintage clothing and accessories and are located in Denmark. Also women who want to exchange give their clothing a second life and are interested in circular fashion.
Trendsales https://trendsales.dk/	Trendsales is a secondhand application and website where users can sell and buy secondhand fashion items, furniture and electronics. Users are in charge of selling and sending either through the app or at a pickup	Everyone interested in purchasing and selling secondhand items in Denmark. As trendsales also sells children's clothing it markets to many customers.

	location. Other shoppers can see users' profiles and contact them directly.	
Zadaa https://zadaa.co/	Zadaa is a secondhand application where users can sell and buy secondhand items. Users can upload their clothes, cosmetics, accessories and shoes, be in contact with potential customers and take care of the selling of their item from uploading to sending. Other shoppers can see users profile and contact them directly.	Women located in Denmark, Germany and Finland who are interested in buying secondhand. Also, women who are interested in buying and selling secondhand items.
Sellpy https://sellpy.dk/	Sellpy is a secondhand website and application where users can buy secondhand items. Users can also sell their clothes through sellpy by sending their items to the company which afterwards takes care of everything from uploading to selling. Sellpy donates items unsuitable for sale.	Users located in multiple countries in Europe, who are interested in buying fashion, home decor, electronics, toys and other small items online. Sellpy also targets users who want to sell their clothes and other items online.

Key attributes for comparison

Chosen dimensions for comparison can be either obtained by asking users or by choosing ourselves. (Goodman et. Al, 2012) Since the important features of online secondhand were later discussed with users in the interviews and since the purpose of competitor analysis is to understand which features online secondhands have, to better understand the platform, users were not included in the competitor analysis. The features for comparison were chosen based on the article by Scacca(2020) about a good e-commerce UI design. This article described which features and functionality is necessary for a high-quality e-commerce design. Features which were not applicable for secondhand e-commerce such as product variant information and stock availability were omitted.

Chosen features for comparison were:

- Information about the item – pictures, price, original price (op), condition, material, color, measurements and size.
- Filtering of the items by – price, brand, size, material, condition, location.
- Sorting of the items.
- Items categorized
- Similar items section
- Recommended items section
- Popular items section

- Sectioning of the items
- Wishlist functionality
- Reviews
- Chat function

Competitor comparison

Competitors were compared based on chosen features in the table below.

Table 2 Competitor comparison

	&Lu	Veras	Trendsales	Zadaa	Sellpy
Item information	Pictures, description, size, condition, material, color, size, price, op	Pictures, description, category, size, quality, condition, color, style, print, measurement, size, material, brand, item n.	Image, rest is depending on the seller, usually at least category, condition, size and price	Pictures, description, condition, category, fit, fit for seller, material, price	Image and depending on the item, at least brand, type, size, color, pattern, category, condition
Filters	Stock, size, brand, item, price	Brand, size, category, quality, condition, material, print, color, style, price, stock	Category, brand, location, condition, color, price	Category, brand, material, size, price, color, location	Size, brand, item, category, condition, color, material, pattern, price
Sorting	Alphabetic, price, newness, bestsellers	No	Price, newness	no	Popularity, newness, price
Categories	Season and items	Style and items	Items, season, brands	New in, most wanted, trending, season	Items, style, brand
Wishlist	no	yes	yes	yes	yes

Items sections	Similar items	Similar items	Similar items, recommended items, popular items	Popular items	Similar items, recommended items, popular items
Reviews	no	no	Yes, reviews of buyers and sellers	Yes, reviews of buyers and sellers	Buyers can leave reviews about the purchase; these serve only as feedback for the company.
Chat	yes	No, just email	Yes, chat with seller	Yes, chat with seller	Yes

Based on the comparison of key dimensions of chosen Tier 1 competitors the following functionalities were chosen as the base functionalities for secondhand e-commerce:

Information about the item: The website should provide images of the item, description, size, condition, category, color and material of the item if available.

Filtering the item: Website should provide filter option for the size, brand, material, condition, color, price and category of the item.

Sorting the item: Website should provide sorting of the items based on the price and newness

Categories of the item: Website should categorize items based on item type and offer category of items for the current season.

Sections for the items: Website should provide similar items section and popular items section.

Wishlist: Website should provide a wishlist functionality so user can save items they like for later.

Reviews: Website should provide a place where customers can leave reviews either about a seller or about a purchase (when buying from a company).

Chat: Website should provide a chat function so buyer can get into contact with seller, or buyer can contact company regarding any questions.

Stakeholder analysis

The purpose of stakeholder analysis is to identify and analyze organizations and people, to better understand their interests, relations and behaviors and their influence. (Varvasovszky & Brugha , 2000) It is also done to know which stakeholders should be focused on and what kind of attention should be given to each stakeholder group. (Jepsen & Eskerod, 2009). This was an important step in not only gathering knowledge about the secondhand e-commerce platform but also people who are affected by it.

Stakeholder analysis can be done in a short time of a few weeks or over a span of a month, depending on the resources available and the purpose of analysis. (Varvasovszky & Brugha , 2000) It consists of following actions: Identifying stakeholders, characterizing stakeholders based on their expected contribution and their power, and deciding actions to be taken towards each stakeholder group (Jepsen & Eskerod, 2009) Since I had limited time for this Master Thesis, as well as limited resources, the purpose of stakeholder analysis was only to identify the main stakeholders who are most affected by this project, characterize them based on their power and decide which group would be focused on and investigated more in depth.

I outlined the following stakeholders: Customers (Buyers and Sellers), E-commerce owners, Management, Executives Web developers, UX designers, UI designers, Suppliers, Payment services providers, delivery providers.

To get a better understanding of the influence of these stakeholders, I divided them into Power Matrix suggested by Mendelow(1981). The power is situation specific and can vary in different contexts. It can be based on different sources such as possession of the resources, availability of alternative resources, having general authority, influence over other stakeholders (Mendelow, 1981).

While considering all the above-mentioned influencing factors, I divided stakeholders below:

Table 3 Stakeholder analysis Power Matrix

High power, low interest Keep satisfied	High power, high interest Engage closely, keep satisfied
Web developers UX designers UI designers Marketing team	E-commerce owners Management Executives
Low power, low interest **Least important, minimal effort.**	**Low power, high interest** **Show consideration, keep informed.**
Suppliers Payment services providers Delivery providers	Customers – both buyers & sellers

High power, high interest stakeholders are the people who are very interested in the success of the product and at the same time have the power to influence the product. When it comes to secondhand e-commerce these are the owners of the company, management, and executives as they strive to keep the company successful and have the main word when it comes to changes or updates to the product. These people should be managed closely and there should be a lot of effort to satisfy them.

High power, low interest stakeholders are people who have influence over the product, however, are not as interested. Their needs should be met as they are still important for the company, and it is important to keep them satisfied. Here belong people who have effect on the product, such as developers, UX & UI designers, and Marketing team.

Low power, low interest stakeholders are people who do not have much interest or power in the company. These are people who do not have to be constantly updated with the newest information and their engagement should be kept to necessities.

Low power, high interest stakeholders are people who are very interested in the company but do not have any power over it. These people should be kept updated about new information and they can also bring valuable feedback on any areas that need improvement which is what was desired when making the heuristics. In secondhand e-commerce case here belong customers, who when it comes to customer-to-customer business type can be both sellers and buyers. Customers are important for the successful running of the company. User experience of the user interface and the solution in general affects the satisfaction of the customers and can affect the company's reputation and sales as mentioned before. That and the fact that customers have valuable feedback towards the platform is why these stakeholders were the focus of my Master thesis and the support for proposed heuristics.

Experimental stage

In the experimental stage, researchers can perform extra methods to gather additional heuristic information regarding the platform or any other information which has not been defined in previous stage. This step is optional. (Quiñones et.al., 2018). Even though this step is not mandatory, I believed that based on the research which has been described in literature review, that states that involving users in design of e-commerce can be beneficial for user experience, it would be good to include real users in this methodology. Even though this is not about design per se, it is still about designing heuristics which portrait features and qualities that are important for the user. Therefore, I decided that gathering qualitative data from users by performing interviews would bring valuable information regarding their preferences, needs and secondhand e-commerce platform.

Interviews

A qualitative interview's aim is to understand the interviewee's point of view on the world. Through this interaction, new knowledge is produced. Qualitative interview provides descriptive and specific information about the users (Kvale & Brinkmann, 2009). Advantage of this method compared to some quantitative methods, such as surveys, is the ability to dig deep and gather descriptive and detailed responses which other way would be hard to capture (Bryman, 2012).

The purpose of conducting a qualitative interview was to gather user's opinions and preferences for secondhand e-commerce. The information collected from these interviews was used in two different ways. First was to use gathered information about the users as a base for creating personas. Second was to use the information to discover user requirements for secondhand e-commerce. These user requirements describe the desired features of secondhand e-commerce which are needed for the next step of the methodology.

This social research method seemed the right strategy as it would provide descriptive and specific information which would serve as a base for user suggested heuristics. The interviewing process consists of 7 stages: conceptualizing the interview, designing the interview, interviewing, transcribing, analyzing, and reporting the data (Kvale & Brinkmann, 2009).

Based on when in the cycle is interview performed, there can be exploratory interviews, requirements gathering, prototype evaluation and summative interview to evaluate already existing product (Lazar et. al., 2017).

Explorative interviews are used in the beginning of development and are meant to help understand user needs and goals. These are usually performed to invent a new product and questions are not focused on specific functionality or design. These types of interviews try to uncover what it is that the user wants (Lazar et. al., 2017). This type of interview would be great if the purpose of this research was to produce a new platform or a way of selling the items. But since this is just a supplementary method for developing new heuristics for an already existing type of platform this type of interview is not suitable. Summative interview was also not chosen since I was not working with specific existing solution on a market, as its purpose is to evaluate already existing products or to summarize the issues and emotions a user has towards a specific product and can be combined with further methods, such as user testing (Lazar et. al., 2017).

Since the goal of an interview is to understand user needs and specific design features, the type of interview used for gathering product requirements was implemented. Here questions should not be too narrow or focus on existing tools but instead be broad and cover areas such as users' **practices, goals, frustrations, and concerns**. (Lazar et. Al., 2017) These areas inspired questions of the interview which were about user goals, if and how they are met by current tool, is there is anything they are unable to do or if they are experiencing any frustration with their tool or even how they imagine a perfect tool. (Lazar et. Al., 2017)

Depending on the structure of the interview, the interview can be a fully structured interview, which follows a strict script, and no unexpected questions are to be asked. A semi-structured interview is a more suitable type for my research as it still follows a script but allows more room for clarification and additional non-scripted questions and is recommended when looking for design requirements or other insights. (Lazar et. Al., 2017)

When it comes to semi-structured interviews it is still good to write an interview script which can be followed and lead the interviewer through the process. This can vary from just a list of areas to be covered to specified questions. (Bryman, 2012). Interview script was written to ensure consistency between different interviews and to help me remember the questions and important topics to ask about (Apendix 1, section 2).

Sampling

After the type of interview has been defined it is important to find subjects to interview. There are different ways to find these and the theory for choosing the subjects is called sampling. In quantitative research sampling is divided into probability sampling and purposive sampling. The type of sampling is chosen based on what the research question proposes. Purposive sampling samples participants that have some relevancy to the research question. Bryman, A. (2012).

Based on the research questions and the stakeholder analysis I decided to choose women who shop secondhand online. The choice of gender was solely because of convenience, as it was easier to get woman participants who previously shopped secondhand.

Depending on the research and the different groups that need to be included, the number of interviews needed can vary (Bryman, 2012). Based on the sampling and the research question only one group of very specific people were included in the interviews, as the software that heuristics are being designed for is specific in itself.

For this Master thesis, 6 interviews were conducted, as Guest et. Al. (2006) made a study which concludes that already 6 interviews conducted with purposive sampling can develop meaningful themes and useful interpretations.

Interview started with the introduction about the purpose of the interview and the length of the interview. The interview questions were divided into 2 sections: buying secondhand items and selling secondhand items. The first section was regarding participants' purchasing habits, motivation and experience with used solutions, frustrations and wishes. The second section was about participants' experience with selling and their wishes regarding the platform from sellers' perspective. All interviews were recorded with participants' permission.

After conducting and transcribing the interviews, I was left with a lot of data which needed to be analyzed so they can be used as a base for user experience heuristics.

The goal of analyzing the qualitative interview is to turn the raw data into detailed information about the problem. This helps to ensure the validity and reliability of the research. One way to analyze qualitative data is to perform content analysis. Content analysis is a replicable process which aims to summarize the content into smaller chunks based on defined rules of coding. (Lazar et. Al., 2017)

In my case the data were transcribed interviews which contained a lot of raw, unstructured text as I conducted semi-structured interviews.

Coding is a technique which originates from grounded theory. It assigns labels to parts of the transcript which have significant relevance to the studied subject (Bryman,2012). Based on how these codes are developed there are 2 different ways of coding: emergent coding, which is inductive method of coding, and priori coding, known as deductive method. Priori coding starts analysis with premade codes based on chosen theory or hypothesis. Emergent coding starts without premade coding categories and creates codes from the data (Lazar et. Al., 2017).

Since the goal of the analysis was to understand user needs regarding the software and their requirements, the codes were specific to software and interviewer's experience with it. At the same time, since there has not been secondhand e-commerce heuristics done before, and the literature on this topic is limited, there were no codes regarding the wanted outcome which I could use that would be specific enough for this case. Therefore, emergent coding seemed like the right choice for the data analysis technique for my interview data.

InVivo coding, also known as verbatim coding, literal coding, and natural coding was used to establish codes from the interview. This coding technique creates codes from participants' words and puts importance on the words of participants and does not rely on pre-defined codes (Manning, 2017).

Analysis was done by reading through interview transcripts multiple times. After reading through the interview, I identified **34 codes**. These were the initial codes from the interviews: Features, Label, Recycling, Filters, Sections, Measurements, Price, Condition, Quality, Material, Chat, Moderator,

Pictures, Favorites, Returns, Reservation, Storing the data, Company, Packaging, Reviews, Rating, Delivery, Customer Service, Similar items, Notifications, selling items, Important information, Contact with seller, Bad experience, Platform type.

Sentences and snippets of text which were classified under these codes were afterwards rewritten in the form of requirements. After these quotes were rewritten many of them came together as they were saying the same thing but differently. These sentences were divided into the following categories:

Company recommendation: Features, Recycling, Moderator, Returns, Company, Packaging, Delivery, Customer Service, Bad experience, Platform type.

Website's features: Reviews, Rating, Filters, Sections, Chat, Reservation, Storing the data, Similar items, Notifications

Product information: Label, Measurements, Price, Condition, Quality, Material, Important information

Selling the items: Selling items, Contact with seller.

All these categories apart from the selling, were further divided into "Company e-commerce" and "C2c e-commerce" as some of the features are not applicable in both types.

The following are the results of the interview coding written in the form of requirements divided into categories: Website's features and Product page features. Requirements related to selling were divided under those categories as well, as there was nothing too specific which would need its own category.

System requirements describe what the system should do and the services it should provide. User requirements are statements in a natural language and should reflect customers' needs regarding the system. These requirements are written in natural language sentences, which are typically numbered, and each sentence equals one requirement (Sommerville, 2010).

Website's requirements (for both types)

- The website should offer a filter for size.
- The website should offer a filter for price range.
- The website should provide a filter for color.
- The website should provide filters for types of material.
- The website should provide a filter based on styles.
- The website should provide a filter for the brand.
- The website should provide an option to filter based on the measurements.
- The website should provide sections based on item type.
- The website should provide sections based on style.
- The website should provide sections based on season.
- The website should display a "popular items" section.
- The website should display a "recommended items" section.
- The website should provide save to favorites function.
- The website should save favorites even without logging in.
- The website should save shopping cart (items) even without logging in.

Website's requirements (b2c company):

- The website should provide a place to read and leave reviews of the company with a place for customers to upload the images of their received items.
- The website should provide information about the location it is shipping from.

Website's requirements (c2c company):

- The website should provide a filter for location.
- The person should be able to place an item with a bidding option for a price.
- The website should provide a chat function so the buyer can contact the seller with inquiries.
- The website should provide visible reviews of the seller.
- The website should provide visible reviews of the buyer.
- The seller should be able to review the buyer
- The buyer should be able to review the seller.
- The website should provide space for leaving more elaborate reviews including images, description, and rating.
- The website should display other items that the seller is selling.
- The website should provide a profile for seller and buyer so users can see who they buy items from.
- The website should provide a chat function so the buyer can contact the seller with inquiries.
- The seller should not be able to contact the buyer without the buyer contacting first.
- The seller should not be notified about people saving the item into favorites.

Product information (both platforms):

- The website should provide information about the size of the item. (based on the label)
- The website should provide information about the condition of the item.
- The website should provide information about the material of the item where possible.
- The website should provide a picture of the item label where possible.
- The website should provide information about the color of the item.
- The website should provide the original price of the item if possible.
- The website should display how many people are looking at the item you are browsing.
- The website should display how many people are interested in the item (wishlist count.)
- The website should only allow upload of unedited images of the items.
- The website should provide "similar items" section.

Product information (b2c platform):

- The website should provide the measurements of the item
- The website should provide images of the item on a figurine or a model.
- The website should provide good quality images of the items.

Alongside requirements, which were important in developing the heuristics as they described the desired features, these interviews also provided recommendations for secondhand e-commerce platforms which could be useful for a business's developing such solutions. Most of these suggestions came from asking participants about their “ideal secondhand webshop”, but some also came from analyzing the other parts of the interview.

When it came to the structure of the webshop, some participants mentioned that they would like the structure to look similar to normal fashion e-commerce websites but with updated categorizing and filtering, so it fits the number of items that usually occurs at secondhand webshops. One participant mentioned that they would like a website that would include both types of secondhand e-commerce, people selling their items and also companies selling their items.

When it comes to secondhand company e-commerce (b2c type) multiple participants mentioned that the company should be transparent about their intentions, visions and goals and it should aim to be as green as possible, to promote sustainability throughout their business and not just by the type of items they are selling. Company should take responsibility for incorrect information they state regarding their items, do thorough quality check and try to use eco-friendly or reusable packaging and provide help for the customers if the items received are different than described, or if they might have any other issues. The company should provide an option for returning the items. When it came to shipping, multiple participants mentioned that they would prefer reasonably priced shipping and that the company should ship the items within the mentioned times. When it comes to people selling their items through their platform, participants stated that the company should accept multiple brands of items and possibly provide an option to send items for recycling as well. Most suggestions regarding secondhand e-commerce of c2c type were regarding customer service. As many times, sellers can write incorrect information on their platform, customers service should help users with bad purchases and in case the items received are different than described and should be the main helper rather than being the last help after the buyers and sellers failed to resolve the issue between each other. They should also aim to verify sellers and buyers to avoid having scammers on their platform. The company should also try to create multiple pickup points for the buyers, so fulltime working people can get their items comfortably outside of working hours.

Personas

There are different ways of representing information about the chosen application domain. When representing systems, it is suitable to use process maps, when representing situations, it is good to use scenarios and when representing people, it is suitable to use personas. (Goodman et. al., 2012)

Personas are a way of delivering information about users and diverse groups of people who use the product. (Goodman et. al., 2012) They are less complicated and easier to understand than results of interviews or questionnaires directed at user requirements. (Thoma & Williams, 2009)

Personas were used as a way of describing the target audience of secondhand e-commerce.

They represent user goals and behaviors and can help make decisions about the interface design of a solution, features or interaction. They are not real people but more of a memorable character. (Goodman et. al., 2012) By creating a persona, development team and other teams within the company can refer to a product through a persona and see their product from the customer’s perspective. (Pruitt

& Grudin, 2003) Personas created in this report can be used as a base for personas used in the development of secondhand e-commerce.

Studies show that incorporating personas into user-centered design can help focus product design teams on the goals of customers and integrate their needs as a central point of choosing the design processes. By satisfying 100% of persona's needs it is more likely that the product will satisfy potential customers as well (Miaskiewicz & Kozar, 2011). To create believable persona, it is important to use quantitative and qualitative data collection for gathering information about the users (Thoma & Williams, 2009). There are different methods which can be used, such as interviews, market research, data usage and customer feedback. (Goodman et. al., 2012)

To create my personas, I used the information collected about the user's characteristics, their motivation and secondhand shopping habits from the interview. Making personas requires identifying important behavior patterns and turning them into sets of crucial characteristics. It is also important to identify any demographics which affect personas behavior (Goodwin, 2009). Unfortunately, I only performed 6 interviews data that I had to work with for creating personas were limited. I categorized my interviewees based on their demographics (age, location, job status), their secondhand shopping habits and motivation, their needs, and their goals when it comes to using secondhand e-commerce as these were important users' characteristics for my research. Styvén et. al.(2020) divides secondhand shoppers into 4 categories as mentioned in literature review: price conscious customers, style and quality conscious customers, environmentally and socially conscious, and brand and self-expressive conscious consumers. These categories were also present in the interviews and personas were categorized accordingly.

Below are some of the persona-types which arose from the interview:

Anna

style and quality conscious customer

"I want to be able to search items and find easily what fits my style and ocassion I am shopping for."

Profile

Age : 22
Location: Slovakia
Job status: Philosophy student
Relationship status: In a relationship

Goals

- Want to find good quality clothes that fit her size
- Wants to find interesting items which she cannot find in normal shops
- Wants to be able to find what she needs and likes without spending too much time browsing the webshop

Needs

- Needs to be able to filter items based on multiple characteristics
- Wants to see clothing categorized by style and events
- Wants to be able to search items based on the material
- Wants to be recommended items which she might be interested in

Figure 5 Persona type 1

Some of the participants could be categorized as style and quality conscious customers. These types of customers are shopping secondhand because they can find interesting items which are usually different style and better quality than items they can buy in normal shops. For them it is important that they can search for clothes of specific material and style that they are interested in. Since when shopping secondhand, the number of items can be overwhelming, and they know which types of items they are interested in. This does not necessarily include the brand, as they are mainly interested in unique, even vintage pieces. These customers need good filtering and sectioning options.

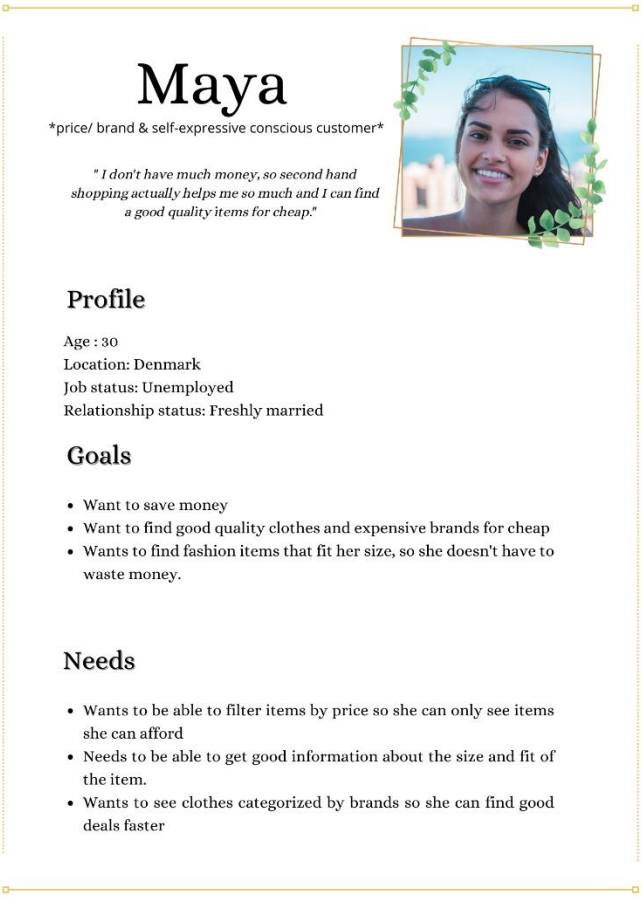


Figure 6 Persona type 2

Some of the participants could be categorized as price conscious and brand & self-expressive conscious at the same time. These participants are interested in finding branded or designer items cheaper than in a normal shop, but also shopping for non-branded items secondhand to save some money. These are usually people who have limited monetary resources. They usually know what they want, but it is important for them that they have all the information they need about the item and can filter based on it, so they decrease the change of these items not fitting them. As they don't have money to waste on buying clothes that don't fit, even if they buy them secondhand. These customers need filter for price, good information about the items and see the items categorized by brand.

Julia

environmentally and socially conscious customer

"I think people consume a lot and there are so many good products out there that can be reused"

Profile

Age : 29
Location: Netherlands
Job status: Social research worker
Relationship status: Single

Goals

- Does not want to support over consumerism
- Wants to be environmentally friendly while shopping
- Enjoys a good feeling of shopping secondhand and supporting circular economy
- Wants to get good quality clothing which will fit her style and size at first try as she does not like to shop often

Needs

- Want to see good quality unedited pictures of item and its details
- Needs to be able to contact the seller, to get extra information about the item
- Wants to see the reviews of the seller and the company
- Want to see know information about the company and their intentions

Figure 7 Persona type 3

Some of the participants could be categorized as environmentally and socially conscious customers. These participants are usually shopping secondhand, because they don't want to support overconsumption, unethical and unsustainable fast fashion practices. These are the people who usually shop for fashion from sustainable fashion brands, or they buy it secondhand as those sources are perceived as sustainable from their perspective. They don't usually buy clothes too often as they don't want to support overconsumption and materialism, so when they buy clothes, they want to make sure that they are making the right choice. Therefore, these people need good quality and unedited pictures of the items and their details. They are also interested in reviews of the seller, to see if the seller is reliable and they are making the right decision purchasing from them. They also need to be able to contact the seller with further inquiries about the item. Visible information about the company, their intention and business and reviews are also important for them.

Descriptive stage

In descriptive stage, all the information selected in step 1 and step 2 are collected and categorized.

They are usually grouped based on the following topics:

1. Application features specific to the chosen application domain,
2. UX and usability attributes that can be evaluated with heuristics,
3. Any relevant heuristics and heuristics created for similar applications,
4. detected usability problems (optional).

Based on the importance for the research, each information from these groups is evaluated separately and assigned a value:

1 -not important,
2 - somewhat important,
3 - very important (Quiñones et.al, 2018).

Since I did not perform a usability test during the exploratory stage to detect usability flaws, group 4 was omitted.

Once this information is collected, they are assigned a value of importance as described below. Chosen values for this information need to be justified. Only the information that is assigned value of 3 will be further used in the next step of methodology. The rest will be discarded.

Information regarding secondhand e-commerce prioritized:

To understand the platform better I gathered general information about e-commerce platforms by Nemat (2011), Ritter & Winterbottom (2017) and Tharindu (2021). I only selected the first two as the most important since they provided more thorough descriptions and information than Tharindu (2021).

To understand secondhand, I gathered information for definition of secondhand by Visconti et.al. (2013), definition of online secondhand shopping intentions and motivations by Fabien et.al. (2016) and Styvén & Mariani (2020). Definition of secondhand motivators by Hur (2020) and Guiot & Roux (2010) were not selected as they only targeted physical secondhand markets.

To see the details about the values and justification for each piece of information please refer to Appendix 1(Table 1).

Information regarding secondhand e-commerce features prioritized:

Bonastre & Granollers (2014) created 64 generic heuristics for e-commerce. These were written in the form of a checklist for the features and functionality of the platform and were therefore more suitable to be used for defining generic e-commerce features than for defining heuristics and were assigned

value of number 3. Also, they were more elaborate than Fang & Salvendy (2003) which only contained 29 features, or Kim & Lee (2002) which were very much focused on the product information. For these reasons they were both assigned a value of 2.

Because I didn't find any sources that would provide a list of features for secondhand e-commerce, I performed competitor analysis and interviews to gather these requirements and features. Since the interviews were conducted with only 6 participants, the results are not necessarily generally applicable. Therefore, I decided to evaluate each feature individually by creating a survey. Both competitor analysis and survey were assigned a value of 3 as they provided domain-specific user-based features. To see the details about the values and justification for each piece of information please refer to Appendix 1(Table 2).

Survey

A survey was chosen as a method to evaluate the validity and general applicability of the features and user needs and functionalities uncovered in experimental stage during the interviews. Compared to qualitative methods, which provide information about why people do what they do, surveys allow users to describe who they are, what their interests and preferences are (Goodman et.al., 2012). It is a set of defined and well-written questions for people to answer. It is usually carried out by the person himself, without the researcher being present. Surveys cannot get deep detailed information, rather big amount of shallow data (Lazar et. Al. 2017). As I already gathered qualitative data regarding users' habits and preferences, the survey was a way to evaluate these results and avoid personal biases from interviewed people.

The inspiration for the survey came from a research article by Ingaldi & Ulewicz (2019) about how to make e-commerce more successful in sustainable development. They used Kano's model for assessing customer satisfaction and defining the features of e-commerce with organic products. Respondents of the survey evaluated sustainability attributes and features of the e-commerce by choosing from responses: "I like it", "That is the way it has to be", "I do not mind it", "I can put up with it" and "I do not like it". As stated in literature review, this is based on the structure of Kano's satisfaction model(Matzler et. Al., 1996). Since the goal of my survey was not to understand the popularity of the features, but to understand the necessity of the features I changed the response choices to answer the level of importance instead. However, this study still affected my Master Thesis as it brought the idea of evaluation of the features with a survey.

There are different types of surveys based on when they are performed and what their intention is: profile survey, satisfaction survey and value survey (Goodman et.al., 2012). As profile survey is meant to profile the users, which is not something that was the goals for this method, and satisfaction survey is evaluating users' satisfaction with the current tool, which was also not the focus of this method, a value survey was chosen instead. A value survey is trying to understand what users find important, and in my case, this focused on the importance of the features and functionality of secondhand e-commerce. The goal of this survey was descriptive – to describe user's preferences (Goodman et.al., 2012).

There are two different types of survey goal: descriptive – which attempts to describe the audience, explanatory - aims to explain people's behaviors and beliefs based – describing the audience's beliefs by making the connection between their answers (Goodman et.al., 2012). As this survey was to either

confirm or refute suggested user needs and requirements, the goal of the survey was descriptive – to describe users, their needs and preferences.

Sampling participants

Sampling the participants for the survey is important as it specifies who the survey is intended for and which channels to use for gathering participants. There are 2 different types of sampling: probability sampling and non-probability sampling (Bryman,2012). In probability sampling, the change of selection of the individual for the survey is known and they have been selected at random, where in non-probability sampling the number of potential respondents is not well-defined because it has not been selected at random (Lazar et. Al. 2017). Since my time and resources were limited and participants in the survey needed to fulfill certain requirements, non-probability sampling was chosen for this method. To avoid bias when sampling participants, it is important to not decrease the chance of people's inclusion in the sample, by not influencing it too much with personal judgement (Bryman,2012). I used 2 different types of non-probability sampling: convenience sampling and snowball sampling. Convenience sampling a sample gather from what is available to the researcher (Bryman, 2012). Here I contacted people who I know that tried secondhand fashion shopping online and I also reached out to online communities that were of similar topic. Snowball sampling is a form of convenience sampling, where researchers contact the initial people who fit the category and then they ask them to pass survey to more relevant people (Bryman,2012). I used this by asking my friends and family, who already fit the category, to pass it on to any relevant people who could bring valuable insights for this research method. The survey should also include variety within demographics of participants, including age, gender, education etc.(Lazar et. Al. 2017) That is why I didn't limit my sample by gender or age, only by participants' experience with online secondhand shopping as that was the important factor and could not have been omitted.

Structuring the survey:

Survey usually contains 4 parts: the introduction, the beginning, the middle and the end (Goodman et.al., 2012). Introduction should describe purpose of the survey, instructions for filling it up, duration and similar. Introduction to my survey contained the purpose of the survey, description of secondhand e-commerce and its different types and the duration of the survey. Since this survey has been spread through multiple channels and some people who raised interest might not have experience with secondhand shopping, the introduction included the question about participants' shopping experience. Only people who shopped secondhand fashion online or at least tried different secondhand websites or apps continued with the survey. The rest were guided to the thank you screen.

The middle of the survey was the main part, containing the most important questions. I divided it into sections to make it less overwhelming and to make more sense for the participant: secondhand item product page information, secondhand website features, platform to sell and buy from other people, rating and reviews and about you.

While rewriting results of interview analysis into survey questions, I kept it mind they need to be clear and straight forward, so they are not unambiguous and confusing for people. I used closed-ended questions as they require more effort for answering and therefore, I could potentially get more people to complete the survey. Close ended questions can have ordered – Likert scale-based answers or unordered response categories (Lazar et. al., 2017). For people to feel comfortable answering close

ended questions, the questions need to be specific, comprehensive and mutually exhausting (Goodman et.al., 2012).

Since after analysis of the interview I ended up multiple features specifications and preferences regarding e-commerce user experience and interface, I combines both types of answer categories.

For statements from the interviews, I used Likert scale answers. Likert scale is a set of offered statements for participants to choose from, that signify a level of agreements with the statements on a metric scale. There are different variations of this scale, and it varies between 5-, 7- or 10-point scale with the neutral answer lying in the middle (Joshi et.al., 2015). A decision to which type of answer to use for these statements was based on Likert Scale Response Options by Vagias & Wade (2006). I used the following 5-point scale 1 – Strongly disagree 2 – Disagree 3 – Neither agree nor disagree 4 – Agree 5 – Strongly agree. To view the full survey structure, please refer to Appendix 1(document 2).

With the statements regarding suggestions for the website, preferably each suggestion should be evaluated by importance on its own, however due to limited resources I ordered related suggestions into categories and used unordered responses for those cases. Some of the requirements/features were repeated in the survey from the competitors' analysis, however, they were still evaluated to understand their importance.

The survey ended with a thank you screen. The software used was hosting the survey was Google Forms, which provides a fast way to develop a survey and provides statistics for the answers.

Using survey that was hosted online limited the participants to only people who have access to the internet and know how to orientate themselves on a web. This could sometimes be a negative since it reduces the number of potential respondents (Lazar et. al., 2017). However, in my case, web usage awareness was an important quality of people who I wanted to answer, since they would be responding questions regarding a web solution.

It is important to pilot test the survey before running it, to see that the answers are clear, and everything is working as expected (Lazar et. al., 2017). Due to the limited time and resources, I only tested the survey with 2 different people and updated the answers and structure based on their feedback.

Survey analysis & results

Before analyzing the results, collected data should be cleaned and to see that each response is valid (Lazar et. al., 2017). Altogether, I gathered 82 responses. However, out of these, 14 people selected that they haven't tried shopping secondhand online and therefore were directed to the thank you/goodbye screen. Some of the answers from the rest were incomplete and therefore invalid and removed. In the end I ended up with 60 valid responses.

When it came to analyze the gathered data, one was to analyze the quantitative data is to use the counting technique which counts all the value responses to each question. (Goodman et.al., 2012) This technique was chosen for my case, as the purpose of the survey was to quantify and explore the relevancy of suggestions from interview to general public.

Based on the results of the analysis, 42.2% of the people who took the survey purchased secondhand fashion online many times, 40.7% of the people purchased a few times and 16.9% of the people tried

some apps or websites but ended up not making the purchase. 65% of the participants in the survey were in their 20's, 21.6% in their 30's, 5% in their 40's, 3.3% were under 20 and 1.6% were above 50. 86.6% of the participants were women, 5% were non-binary,3.3% were male and 1.6% preferred not to say their gender.

When it came which information is important for participants and should be on the product page 91.6% chose that there need to be **good quality images of the item**, 90% agreed that there should be **a size based on the label (size from the brand)**,85% agreed that there needs to be stated **the condition of the item**, 75% agreed that there needs to be item's price, 71.6% chose that there needs to be **the material of the item(if possible)**, 68.3% agreed that there needs to be **color of the item** stated, 60% agreed that product page should provide **image of the item on a figurine or a person** and 53.3% of participants agreed that there should be the **image of the label**, if possible. Only 35% of people agreed that there should be measurements of the item and original price of the item, 31.6% agreed that there should be similar items section and 15% agreed that there should be displayed how many people saved the item and 5% of people agreed that there should be displayed how many people saved the item into their wishlist.

86.6% of respondents agreed that a website should **only allow upload of unedited images** of the product item, with 56.6% responding with strongly agree and 30% with agree.

When it came to which filtering option the website should offer for the products page 93.3% of people agreed that there should be **a filter for size**, **price range** and **condition**, 80% agreed that there should be a **filter for the location or distance of the seller**, 75% agreed that there should be a **filter for color**, 70% agreed that there should be a **filter for brand**, 65% agreed that there should be a **filter for material**. Only 38.8% agreed that there should be a filter for style and 35% agreed that there should be a filter for measurements (ex. sleeve length).

When it came to which sections for products websites should offer, 91.6% of people agreed that there should be a **sectioning based on item type**. Only 40% agreed that there should be a popular items section,35% of people agreed that there should be sections based on the style and recommended items and 25% agreed that there should be a section based on the current season.

93.3% of participants agreed that a website should provide **save to favorites** function, with 63.3% responding strongly agree and 30% responding agree.

52.5% of participants agreed that a website should **save favorites even without logging in**, with 32.3% responding strongly agree and 20.3% responding agree.

61% of participants agreed that a website should **save the shopping cart even without logging in** with 39% responding strongly agree and 22% responding agree.

86.4% of respondents agreed that the secondhand company(b2c) should provide **information about the location** it is shipping from, with 52.5% responding with strongly agree and 33.9% with agree.

52.6% of respondents agreed that the person selling on the platform should be able to **place an item with a bidding option for a price**, with 10.2% responding with strongly agree and 42.4% responding with agree.

91.5% of respondents agreed that the website should provide a **chat functio**n so that buyers can contact the seller with inquiries with 52.5% responding with strongly agree and 39% responding with agree.

74.6% of respondents agreed that the **website should display other items that the seller is selling**, with 30.5% responding with strongly agree and 44.1% responding with agree.

69.5% of the respondents agreed that the **website should provide a public profile for sellers and buyers** so users can see who they buy items from, with 35.6% of respondents replying with strongly agree and 33.9% responding with agree.

56.6% of the respondents agreed that the **seller should not be able to contact the buyer without the buyer contacting first**, with 23.7% responding with strongly agree and 33.9% with agree. 25.4% of respondents were neutral about this statement.

Only 45.8% of people agreed that the seller should be notified about people saving the item into favorites, with 6.8% responding with strongly agree and 39% responding with agree. 42.4% of respondents were neutral about this matter.

When shopping on customer-to-customer platform 90% of people agreed that the **buyer should be able to review the seller**, 76.6% agreed that website should provide **visible reviews of the seller** and that **seller should be able to review the buyer** and 60% agreed that the website should provide **visible reviews of the buyer**.

84.8% of respondents agreed that when shopping on c2c secondhand, website should provide space for leaving more **elaborate reviews including images, description and rating of the received items**, with 45.8% responding with strongly agree and 39% responding agree.

89.9% of respondents agreed that when buying secondhand from a company, the **website should provide a place to read and leave reviews** of the company with a place for customers to upload the images of their received items, with 47.5% responding with strongly agree and 42.4% responding with agree.

Based on the results of the survey, the following are each feature and functionalities categorized by importance, as recommended by Quiñones et.al. 2018 for the descriptive stage of the methodology. (See Appendix 1, Table 3)

The values for each feature were assigned as follows: above 50% - value 3 - highly important was assigned, 50-30% - value 2- highly important was assigned, under 30% - value 1 - not important.

Information regarding usability/UX attributes of e-commerce prioritized

Bader et.al. (2017) described 5 user experience attributes which are based on what heuristics evaluation focus on generally and were not based on user experience in general and therefore assigned a value of 2. As attributes of Morville (2004) were not based on previously made heuristics, and could leave more room for developing new heuristics, I decided that these were more important, assigned them a value of 3 and chose them for the development of secondhand e-commerce heuristics. The same logic was applied to choosing usability attributes and the attributes by Nielsen (1994) were assigned a value of 3 and selected instead of Majid et. Al.(2015) as they were more general than specific attributes for

responsive design and were assigned a value of 2. Usability attributes by Nielsen are **Learnability, Efficiency, Memorability, Errors, Satisfaction and Useful**. They were all considered highly important and assigned a value of 3, apart from accessibility which was assigned a value of 2. UX attributes by Morville are **Usable, Desirable, Findable, Credible, Accessible and Valuable**. They were also evaluated all as highly important and assigned a value of 3. To see the values and their justification in more detail please refer to Apendix 1(Table 4).

Existing e-commerce heuristics

Bonastre & Granollers (2014) were the first to create general e-commerce heuristics. However, these were written in the form of a checklist with interrogative sentences and were mainly targeted at the features and requirements of e-commerce. Therefore, these were used as a base for e-commerce features rather than e-commerce heuristics and were therefore assigned a value of 2. Hamid et. Al. (2020) and Ogonowski (2019) both provided an implementation of heuristics by Nielsen in an e-commerce setting. They each described a few example questions for each heuristic. However, these examples do not necessarily cover all possible aspects and therefore assigned a value of 2. Cao et. Al. (2005) proposed 23 heuristics to evaluate information quality of e-commerce website. As these heuristics focus mainly on information quality and don't cover all the features and aspects of e-commerce, they were also assigned a value of 2. Díaz et.al.(2017) used a methodology by Rusu et. Al (2011) to develop 12 generally applicable e-commerce heuristics. This methodology is the basis for the methodology that I am using in this report and therefore these heuristics were chosen as the most important and assigned a value of 3. Bascur et.al.(2021) followed the same methodology as I am using and proposed 11 generally applicable heuristics for e-commerce websites. Since the methodology and applicability of this study was the same as mine, I chose it as the most important and assigned it a value of 3. More details about the values and their justification can be found in Apendix 1(Table)

Afterwards the chosen heuristics were matched together to create a set of heuristics that serve as a base for creating secondhand e-commerce heuristics. Below is a table which created final general e-commerce heuristics based on these 2 studies.

Bascur et. Al.(2021)	Díaz et.al.(2017)	Selected heuristic + identificator
BH1 System and transaction status visibility	DH1 Visibility of system status	H1 Visibility of system status
BH2 Reliability, speed and security of transactions	-	H2 Reliability, speed and security of transactions
BH3 Match between the system and the real world	DH2 Match between system and the real world	H3 Match between system and the real world
BH4 User control and freedom	DH3: User control and freedom	H4 User control and freedom
BH5 Consistency and standards	DH4: Consistency and standards	H5 Consistency and standards

BH6 Error prevention, recognition, diagnosis and recovery	DH5: Error prevention	H6 Error prevention, recognition, diagnosis and recovery
	DH6: Help users recognize, diagnose, and recover from errors	
BH7 Minimize memory load to user	DH7: Recognition rather than recall	H7 Recognition rather than recall
BH8 Flexibility and efficiency of use	DH8: Flexibility and efficiency of use	H8 Flexibility and efficiency of use
BH9 Aesthetic and minimalist design	DH9: Aesthetic and minimalist design	H9 Aesthetic and minimalist design
BH10 Help the user	**DH10: Help and documentation**	H10 Help and documentation
BH11 Payment methods	-	H11 Payment methods
-	**DH11: The information structure**	H12 Information structure
-	**DH12: Accurate and detailed results**	H13 Accurate and detailed results

Table 4 Generic e-commerce heuristics

Features of secondhand e-commerce

To know which features are relevant and should be used in the following steps, I evaluated each feature separately based on the importance. Features from interviews were evaluated by survey. Features from competitors' analysis considered almost all as highly important and assigned a value of 3, apart from the ones that got repeated in the interviews were also evaluated by the survey.

Because of the lack of time, I evaluated feature checklist by Bonastre & Granollers (2014) myself. Since this checklist was meant to be used for heuristic evaluation of an e-commerce solution, it contained also requirements for the solution, rather than just features. However, the requirements which desribed a feature or its implementation were kept as I considered them important for a well-functioning e-commerce.

These requirements were evaluated, and each requirement was assigned value and can be found in Appendix 1 (Table 6).

Methodology by Quiñones et.al. (2018) which I am using, recommends dividing features into generic software/platform features and features specific for the chosen application domain. The following are collected features, which were marked as the most important including their source divided into generic and application specific.

Finalizing the features

Generic e-commerce features:

Feature	source
The website should contain visible navigation throughout all sections.	Bonastre & Granollers (2014)
The website should provide sections based on item type.	Survey, Competitors' analysis
The website should provide sorting functionality for the items.	Competitors' analysis
The website should offer a filter for size.	Survey Competitors' analysis
The website should offer a filter for price range.	Survey Competitors' analysis
The website should provide a filter for color.	Survey Competitors' analysis
The website should provide filters for types of material.	Survey Competitors' analysis
The website should provide a filter for the brand.	Survey Competitors' analysis
The website should provide a filter based on the item category.	Competitors' analysis
The website should provide a filter for condition.	Survey
The website should provide information about the size of the item based on the label.	Survey
The website should provide information about the condition of the item.	Survey Competitors' analysis
The website should provide information about the material of the item where possible.	Survey Competitors' analysis
The website should provide a picture of the item label where possible.	Survey
The website should provide information about the color of the item.	Survey Competitors' analysis
The website should provide the price of the item.	Survey Competitors' analysis
The website should only allow upload of unedited images of the items.	Survey
The website should provide images of the item on a figurine or a model.	Survey
The website should provide good quality images of the items.	Survey, Competitors' analysis, Bonastre & Granollers (2014)
The website should contain a search box.	Bonastre & Granollers (2014)
Search functionality should contain advanced features that specify search criteria.	Bonastre & Granollers (2014)

The search should return the expected results.	Bonastre & Granollers (2014)
The website should provide filters or facets to refine search results.	Bonastre & Granollers (2014)
The website should contain orientation elements, such as breadcrumbs, titles and subtitles.	Bonastre & Granollers (2014)
The checkout process should include the process indicator on the top of the checkout page.	Bonastre & Granollers (2014)
The website should clearly display call to action buttons	Bonastre & Granollers (2014)
The website structure and its areas should be visible.	Bonastre & Granollers (2014)
The website should use elements such as banners to get customers' attention.	Bonastre & Granollers (2014)
The website should advertise new products and special offers.	Bonastre & Granollers (2014)
The website should display the number of current visitors.	Bonastre & Granollers (2014)
The website should not contain outdated content.	Bonastre & Granollers (2014)
The website should contain tools for comparison between products.	Bonastre & Granollers (2014)
Shipping costs and order charges should be specified in the purchasing process as soon as possible.	Bonastre & Granollers (2014)
The website should provide visible information about the delivery date.	Bonastre & Granollers (2014)
The website should have a shopping cart accessible from all pages.	Bonastre & Granollers (2014)
The website should store shopping carts even without logging in.	Survey
The website should provide a wishlist.	Bonastre & Granollers (2014), Survey, Competitors' analysis
The website should store wishlist even without logging in.	Survey
The website should provide chat to assist customers when they need help.	Bonastre & Granollers (2014) Competitors' analysis
The website should contain examples in the form fields to help with the purchase process.	Bonastre & Granollers (2014)
The checkout should be divided into logical steps.	Bonastre & Granollers (2014)
The registration should be simple and only require essential information	Bonastre & Granollers (2014)
The website should provide multiple payment options.	Bonastre & Granollers (2014)
The website should provide space for discount codes in the checkout process.	Bonastre & Granollers (2014)
The website should provide information about the location it is shipping from. (b2c website)	Bonastre & Granollers (2014)
The confirm order button should be visible.	Bonastre & Granollers (2014)
The website should display security logos.	Bonastre & Granollers (2014)
The website should inform of the security level when paying with a credit card.	Bonastre & Granollers (2014)

The website should send a confirmation message after customers' order.	Bonastre & Granollers (2014)
The website should allow order tracking from the customer's account.	Bonastre & Granollers (2014)
The website should allow management of the orders from the customer account.	Bonastre & Granollers (2014)
The interface style of the website should be consistent.	Bonastre & Granollers (2014)
The website's response time and waiting time should be reasonable.	Bonastre & Granollers (2014)
The website should provide personalized contact with the customer.	Bonastre & Granollers (2014)
The website should have a visible privacy policy when personal information is required.	Bonastre & Granollers (2014)
The website should have a visible shipping, return and exchange policy.	Bonastre & Granollers (2014)
The website should contain certificates granted by external companies.	Bonastre & Granollers (2014)
The website should provide different means of contacting the company.	Bonastre & Granollers (2014)
The contact information should be visible during the purchase.	Bonastre & Granollers (2014)
The website should clearly display the address of the company.	Bonastre & Granollers (2014)
The website should provide FAQ section.	Bonastre & Granollers (2014)

Table 5 Generic e-commerce features

Domain specific features:

Feature	source
The website should provide a chat function so the buyer can contact the seller with inquiries.	Survey
The person on c2c website should be able to place an item with a bidding option for a price.	Survey
The C2C website should provide a filter for location/distance from the seller.	Survey
The website should provide reviews of the seller.	Survey
The website should provide reviews of the buyer.	Survey
The seller should be able to review the buyer	Survey
The buyer should be able to review the seller.	Competitors analysis
The B2C website should provide a place to read and leave reviews of the company with a place for customers to upload the images of their received items.	Competitors analysis, Survey

The c2c website should display other items that the seller is selling.	Survey
The c2c website should provide a profile for seller and buyer so users can see who they buy items from.	Survey
The seller should not be able to contact the buyer without the buyer contacting first.	Survey

Table 6 Secondhand e-commerce features

Correlational stage & Selection stage

In the correlational stage all the previous information collected is matched together. This means that UX and usability attributes are matched to heuristics and those are matched with the features (Quiñones et. Al. 2018).

To make the classification more readable while matching the features with usability attributes and heuristics I divided them into categories. However, the categorization from the interviews was not thorough enough, since the number of features increased and there was a need for new categorization. To make them easier to understand, I used the categorization by Mangiaracina et. al. (2009). This categorization divided the e-commerce customer journey into five key phases: site landing, product discovery, product representation, cart management and check out. However, these did not cover all the features, as they only covered the process, therefore category **user** was added.

It is possible that some of the features are not covered by any heuristics. In that case, features are only matched with UX and/or usability attributes (Quiñones et. Al. 2018).

Afterwards, in the selection stage, each heuristic is evaluated based on the correlational stage presented in the table, with the following value of an action to perform **keep** - keep heuristic as it is, **adapt**-update the heuristic, its description or the checklist to suit the chosen application domain better, or **create** - create new heuristic (Quiñones et. Al. 2018).

To make this information more comprehensive, I decided to connect the correlational and selection stage already in this table by adding an extra column which includes the action value I assigned to heuristic.

In case of missing heuristic for a feature I suggested a new heuristic. Names for the heuristics are based on the areas that they relate to, based on the features, as suggested by the methodology. In case of adaptation of heuristic needed I suggest an update.

Section: website exploration

Table 7 Heuristics selection website exploration

Feature	Usability/UX attribute	Heuristic	Action
The website should contain visible navigation throughout all sections.	Findable	**Consistency and standards**	**Keep**
The website should provide sections based on item type.	Findable	**Flexibility and efficiency of use**	**Keep**
The website should contain a search box.	Findable/Efficiency	**Flexibility and efficiency of use**	**Keep**
The search should return expected results.	Efficiency	**Accurate and detailed results**	**Keep**
Search functionality should contain advanced features that specify search criteria.	Findable/efficiency	**Flexibility and efficiency of use**	**Keep**
The website should provide filters or facets to refine search results.	Findable/efficiency	**Flexibility and efficiency of use**	**Keep**
The website should contain orientation elements, such as breadcrumbs, titles and subtitles.	Findable	**Consistency and standards**	**Keep**
The website should clearly display call to action buttons.	Usable / Findable /Efficient	**Consistency and standards**	**Keep**
The website structure and its areas should be visible.	Findable/usable	**Consistency and standards**	**Keep**
The website should use elements such as banners to get customers' attention.	Desirable	-	**Create: Attractive elements**
The website should display the number of current visitors.	Desirable	-	**Create: Attractive elements**
The website should not contain outdated content.	Useful	-	**Create: Correctness, visibility and validity of the information**
The website should provide chat to assist customers when they need help.	Useful	Help and documentation	**Adapt:** Help, contact and documentation

The website should contain examples in the form fields to help with the purchase process.	Memorability	Recognition rather than recall	Keep
The website should display security logos.	Credible	Reliability, speed and security of transactions	**Adapt:** Reliability, speed and security of website and transactions
The interface style of the website should be consistent.	Desirable / Usable	Consistency and standards	
The website's response time and waiting time should be reasonable.	Useful/ efficiency	Reliability, speed and security of transactions	**Adapt: as mentioned**
The website should have a visible privacy policy when personal information is required.	Credible	Help and documentation	**Adapt: as mentioned**
The website should have a visible shipping, return and exchange policy.	Credible	Help and documentation	**Adapt: as mentioned**
The website should contain certificates granted by external companies.	Credible	Reliability, speed and security of transactions	**Adapt: as mentioned**
The website should provide different means of contacting the company.	Valuable	Help and documentation	**Adapt: as mentioned**
The website should clearly display the address of the company.	Valuable	Help and documentation	**Adapt: as mentioned**
The website should provide FAQ section.	Valuable	Help and documentation	**Adapt: as mentioned**
The B2C website should provide a place to read and leave reviews of the company with a place for customers to upload the images of their received items.	Credible/Valuable	-	**Create: Customer feedback**

Section: user

Feature	Usability/Ux attribute	Heuristic	Action
The registration should be simple and only require essential information	Efficiency	Flexibility and efficiency of use	Keep
The website should provide personalized contact with the customer.	Valuable	-	**Create: Personalized user experience**
The website should provide a chat function so the buyer can contact the seller with inquiries.	Valuable/useful	Help and documentation	**Adapt:** as mentioned
The person on c2c website should be able to place an item with a bidding option for a price.	Valuable / useful	User control and freedom	Keep
The c2c website should provide a profile for seller and buyer so users can see who they buy items from.	Credible	**-**	**Create: Personalized user experience**
The seller should not be able to contact the buyer without the buyer contacting first.	Useful	User control and freedom	**Keep**
The website should provide a wishlist.	Desirable/ useful	-	**Create: Personalized user experience**
The website should store wishlist even without logging in.	memorability	Flexibility and efficiency of use	Keep
The website should provide reviews of the seller.	credible	-	**Create: Customer feedback**

The website should provide reviews of the buyer.	credible	-	**Create: Customer feedback**
The seller should be able to review the buyer	credible/valuable	-	**Create: Customer feedback**
The buyer should be able to review the seller.	credible/valuable	-	**Create: Customer feedback**

Table 8 Heuristics selection user

Section: product discovery

Feature	Usability/Ux attribute	Heuristic	Action
The website should provide sorting functionality for the items.	Findable / useful	Flexibility and efficiency of use	Keep
The website should provide a filter for color.	Findable	Flexibility and efficiency of use	Keep
The website should offer a filter for size.	findable	Flexibility and efficiency of use	Keep
The website should offer a filter for price range.	findable	Flexibility and efficiency of use	Keep
The website should provide filters for types of material.	findable	Flexibility and efficiency of use	Keep
The website should provide a filter for the brand.	findable	Flexibility and efficiency of use	Keep
The website should provide a filter based on the item category.	findable	Flexibility and efficiency of use	Keep
The website should provide a filter for condition.	findable	Flexibility and efficiency of use	Keep

The website should advertise new products and special offers.	desirable	-	**Create**: **Attractive elements**
The website should contain tools for comparison between products.	Useful / valuable	Flexibility and efficiency of use	Keep
The C2C website should provide a filter for location/distance from the seller.	findable	Flexibility and efficiency of use	Keep
The c2c website should display other items that the seller is selling.	Useful / credible	-	**Create: Correctness, visibility and validity of the information**

Table 9 Heuristic selection product discovery

Section: product representation

Feature	Usability/Ux attribute	Heuristic	Action
The website should provide information about the size of the item based on the label.	Useful	-	**Create: Correctness, visibility and validity of the information**
The website should provide information about the condition of the item.	Useful	-	**Create: Correctness, visibility and validity of the information**
The website should provide information about the material of the item where possible.	Useful	-	**Create: Correctness, visibility and validity of the information**
The website should provide a picture of the item label where possible.	Useful	-	**Create: Correctness, visibility and validity of the information**
The website should provide information about the color of the item.	Useful	-	**Create: Correctness, visibility and validity of the information**

The website should provide the price of the item.	Useful	-	**Create: Correctness, visibility and validity of the information**
The website should only allow upload of unedited images of the items.	Useful	-	**Create: Correctness, visibility and validity of the information**
The website should provide images of the item on a figurine or a model.	Useful	-	**Create: Correctness, visibility and validity of the information**
The website should provide good quality images of the items.	Useful	-	**Create: Correctness, visibility and validity of the information**

Table 10 Heuristic selection product representation

Section: cart management

Feature	Usability/Ux attribute	Heuristic	Action
The website should have a shopping cart accessible from all pages.	Accessible	Recognition rather than recall	Keep
The website should store shopping carts even without logging in.	Memorability	Flexibility and efficiency of use	Keep

Table 11 Heuristic selection cart management

Section: check out

Feature	Usability/Ux attribute	Heuristic	Action
Shipping costs and order charges should be specified in the purchasing process as soon as possible.	Credible	-	**Create: Correctness, visibility and validity of the information**
The website should provide visible information about the delivery date.	valuable	-	**Create: Correctness, visibility and validity of the information**

The checkout should be divided into logical steps.	Usable / efficiency	Visibility of system status	Adapt: Visibility of system status and feedback
The website should provide multiple payment options.	Useful	Payment methods	Keep
The website should provide space for discount codes in the checkout process.	Useful / valuable	Reliability, speed and security of transactions	**Adapt:** as mentioned
The website should provide information about the location it is shipping from. (b2c website)	Credible / valuable	-	**Create: Correctness, visibility and validity of the information**
The confirm order button should be visible.	Findable / usable	Consistency and standards	Keep
The website should inform of the security level when paying with a credit card.	Credible	Reliability, speed and security of transactions	Adapt: as mentioned
The website should send a confirmation message after customers' order.	Credible / valuable	Visibility of system status	Adapt: as mentioned
The website should allow order tracking from the customer's account.	Useful	Flexibility and efficiency of use	Keep
The website should allow management of the orders from the customer account.	Useful	Flexibility and efficiency of use	Keep
The contact information should be visible during the purchase.	Findable / Credible	-	**Create: Correctness, visibility and validity of the information**

Table 12 Heuristic selection check out

After evaluating each heuristic based on the matched features and usability/UX attributes I ended up with a preliminary set of 13 heuristics, out of which five are original, three are updated versions of original to suit the application domain and five are newly created heuristics.

From the table it can be seen that some of the newly proposed heuristics are not specific to secondhand e-commerce but to cover e-commerce platform in general. For example, a new heuristic called "**Attractive elements"** only covers features which are relevant to general e-commerce and not only secondhand e-commerce. These features were however not covered by existing heuristics. This confirms the research by Tharindu et.al (2021), that states that e-commerce is a complex tool and there is a need for new evaluation tools, as the current ones are not satisfactory. This also happened with heuristic "**Correctness, visibility and validity of the information"** and **"Personalized user experience".** A new heuristic which only covered secondhand e-commerce specific features was "**Customer feedback**". However, even this heuristic could be applicable both to general e-commerce as well after the checklist and description would be adapted.

Three Heuristics were adapted from the original generic e-commerce heuristics. These were "Help, contact and documentation", which required updated name and a checklist to consider specific features. Names and checklists were also changed for heuristics "Reliability, speed and security of website and transactions" and "Visibility of system status and feedback". The description was changed for the heuristic "User control and freedom" to adapt into secondhand e-commerce setting. To see these changes please refer to Appendix 1(Table 7).

Specification stage

In specification stage, the new set of heuristics created in the previous stage is formally specified. The number of new heuristics should preferably be between 10-16 as it is difficult to apply a large number of heuristics in practice (Quiñones et. Al. 2018). Since I created 13 heuristics this falls into the recommended norm.

Following are preliminary heuristics which will be evaluated in the Validation stage:

1. Consistency and standards
2. Attractive elements
3. Personalized user experience
4. Flexibility and efficiency of use
5. Reliability, speed and security of website and transactions
6. Payment methods
7. Visibility of system status and feedback
8. Correctness, visibility and validity of the information
9. Accurate and detailed results
10. Recognition rather than recall
11. User control and freedom
12. Help, contact and documentation
13. Customer feedback

In the specification stage, required information for specification of these heuristics should be defined. If needed, heuristics can also be grouped into categories (Quiñones et. Al. 2018).

A methodology by Quiñones et. Al. 2018 proposes the following template for the specification:

1. **ID of heuristic**
2. **Priority of heuristics: Value which specifies the importance of heuristic in the evaluation of a feature, it can be marked as 3-critical,2-important and 1-useful.**
3. **Name of heuristic**
4. Short definition of heuristic
5. **Detailed description of heuristic**
6. Features or aspect of application domain that this heuristic evaluates
7. **Examples of heuristic violation**
8. **Proposed usability/Ux benefits when following this heuristic**
9. **Possible problems of heuristic misconception**
10. **Checklist of criteria connected with the heuristic**
11. Ux and Usability attributes connected with the heuristic
12. Related heuristics and their original sources

I decided to get inspired by this template. However, to make the specification clearer and easier to use I decided to omit step 4 as it is covered in more detail in step 5, and step 6, as it is covered by checklist in step 10. I also decided to omit step 11 as it was already partially described in correlational stage, and step 12 as some of the heuristics were suggested by other sources than existing literature, such as survey.

The following is an example of a proposed heuristic specified in by this template, specification for all the heuristics can be found in Appendix 1(Table 7)

ID	SEH5
Priority	3
Name	Personalized user experience
Description	The website needs to provide a possibility for the user to create an account and when user is logged in, the website should adapt to the user's needs. This helps the user create a relationship with the website. It also provides a secure community where users can see each other and know who they are buying from.
Violation example	User account icon on the right corner is missing username under the icon, when user is logged in.
UX/usability benefits	Following this heuristic helps website be more desirable, useful and credible.
Problems of misconception	This should not be understood as targeted advertisement of the customer.
Checklist	• Does the website provide an option for sellers to create an account? • Does the website provide an option for buyers to create an account?

	• Does the website change user icon name and greetings based on the customer's account? • Does the website use customer's name and information in the emails? • Is the content and displayed products based on the customer's information and preferences? • Can customers save product to a favorite list or wishlist?

Table 13 Heuristic specification example

Validation stage & Refinement stage

The purpose of validation stage is to perform experiments to validate the effectiveness and efficiency of proposed heuristics. This step is also done to see if there are any further changes that need to be added to heuristics documentation (Quiñones et.al., 2018). Since I had limited time and resources, I decided to evaluate proposed heuristics by performing expert heuristic evaluation on two different platforms previously mentioned in competitor analysis.

Heuristic evaluation

A variety of usability evaluation methods (UEMs) have been developed to evaluate human interaction with a product; these are aimed at identifying issues or areas of improvement of the interaction in order to increase usability (Gray and Salzman 1998).

Usability evaluation methods (UEMs) can be classified based on the evaluation tool or person into user-based UEMs, expert-based USEMs and tool-based UEMS. User based and expert-based methods are frequently used to evaluate the usability of e-commerce websites. Examples of expert-based methods are heuristic evaluation, cognitive walkthroughs and consistency inspections. (Hasan et.al.,2012) Cognitive walkthrough explores user interface from user's perspective and explores their mental processes while performing the tasks (Wilson, 2018).

The heuristic evaluation method can uncover more usability problems and is less costly than the user testing method and usually covers bigger areas of user interface than the user testing (Hasan et.al.,2012).

Heuristic evaluation is usually done by a team of examiners, who evaluate application domain based on the chosen type of approach. Another benefit of choosing this method over user testing is that examiners might also suggest solutions to the usability issues they discovered (Wilson, 2018).

When a single examiner evaluates the product, it is called expert evaluation. Examiner can be an expert in different areas: human-computer-interaction and usability, product area expertise and user and environment expertise. In expert review, examiner can go through about the domain, uses personas to understand user goals and struggles, performs walkthrough of a solution, conducts user interviews, or evaluates the product against heuristics (Wilson, 2014). Since I did not have resources for gathering a

team of professionals to perform a heuristic evaluation, I decided to perform it as an expert evaluation, where I posed as a HCI and usability expert.

There are different ways of heuristic evaluation based on the approach chosen: (Wilson, 2014)

- Object-based evaluation – evaluator evaluates parts of user interface to search for problems relating to the heuristics.
- Task-based evaluation – evaluator performs tasks and pays attention to heuristics-related problems that might occur during these tasks
- Hybrid - which combined the two above mentioned types together.

I decided to perform a task-based evaluation. Tasks were based on the phases of e-commerce customer journey described by Mangiaracina et.al. (2009). This is the same classification I used as an inspiration for dividing requirements into categories. The first step in customer journey is **site landing**, this is about how user reaches the website and through which channels they arrive there. Since this happens before the user arrives on the website, it is not used for creation of a task description. The second step is **product discovery,** this describes how users discover products, find desired items and narrow it down to their final choice. The task for this step is described below:

1. Start from the homepage, go through the products, while using tools such as filters, sorting and search to find a desired item.

The third step is product presentation. This is concerned with presenting the product to the customer, including all the options, features and reviews of the product. For this step I created the following task:

2. Explore product page of the chosen item from previous task, choose size/color etc. and add the item to the cart.

The fourth step is cart management. This focuses on the process of choosing items, adding them to their cart and managing their cart and wishlist before processing further with the purchase. For this step I created the following task:

3. Add a few items to the cart, explore the shopping cart, remove an item and save another item for later, to a favorite or wishlist.

The fifth and last step in customer e-commerce journey is order setup and process checkout. This includes filling in the required information regarding the delivery and performing the purchase. The following is a task for this step:

4. With selected items in cart, go through the checkout process and complete the purchase.

The heuristic evalution with newly created heuristics was performed on 2 different platforms. The first platform was secondhand e-commerce of b2c type, where users of the websites are only buyers called Vera's Vintage, which was also included in competitor analysis. The second platform was secondhand e-commerce of c2c type, where users can be both buyers and sellers called Trendsales, which was also included in competitor analysis.

Website's heuristic violations were assigned values based on Nielsen (1994): cosmetic issue, minor issue, major issue and catastrophic issue.

The heuristic evaluation uncovered 27 usability issues with Veras Vintage website and violation of 11 out of 13 heuristics. Out of those 2 were catastrophic violations, 21 were major violations and 6 were minor.The heuristic evaluation of Trendsales uncovered 13 usability issues. Out of those 1 was catastrophic, 10 were major and 2 were minor violations. To see full evaluation please refer to Appendix 1(Table 8)

Since the evaluation was proven effective with the use of newly proposed heuristics, and there was no need to further refine the set of heuristics and the refinement stage was omitted.

Conclusion

The purpose of this Master thesis was to develop secondhand e-commerce heuristics which could be used for evaluating domain's usability and be also possibly used in the process of design development of such solution. I developed these by following the 8-step methodology by Quiñones et.al (2018).

Based on the process described throughout this report, I provide the following summaries of three research sub-questions and the main question for this project:

RQ1: Do current e-commerce heuristics successfully cover all features of secondhand e-commerce?

To understand, whether current heuristics for generic e-commerce cover functionalities of secondhand e-commerce, I evaluated generic e-commerce heuristics against the secondhand e-commerce features which were defined by following user-centered methods and performing literature review.

Defined secondhand e-commerce features also included features for generic e-commerce. As the proposed heuristics need to be able to evaluate the application domain as a whole, not just the features that are specific for secondhand e-commerce. This is because the proposed heuristics serve as a tool for heuristic evaluation, and the researcher using these heuristics should not need any additional documents to perform heuristics evaluation method on the secondhand e-commerce platform.

During the Correlational stage of the methodology, where I matched features to existing heuristics, I discovered that some features present in generic e-commerce are not covered by generic e-commerce. There were 9 features/requirements which were not covered. When it came to features only specific for secondhand e-commerce, there were 8 features which were not covered by generic e-commerce heuristics. This shows that current e-commerce heuristics do not only not cover all features of secondhand e-commerce, but they are also lacking when it comes to covering all features of e-commerce in general. This confirms research by Tharindu et.al.(2021) mentioned in the literature review.

RQ2: What are secondhand e-commerce heuristics and are they successful at discovering usability flaws in e-commerce?

In my thesis I defined 13 secondhand e-commerce heuristics, which can be used for user experience evaluation. I performed heuristic evaluation of two different types of secondhand e-commerce and

uncovered 27 usability issues on the first website and 13 on the second website. This shows that newly proposed heuristics are successful at discovering usability flaws. These were usability issues that are also applicable for generic e-commerce, proving that create heuristics are effective for evaluating all aspects of the secondhand e-commerce platform.

RQ3: What are the differences between secondhand e-commerce heuristic and generic e-commerce heuristics?

This report also discovers the main differences between generic e-commerce heuristics and secondhand e-commerce heuristics proposed by me. These are mainly regarding user interaction with the seller, customers role as a seller and information regarding the products, which are all very specific features of secondhand e-commerce. For example, the heuristics called "User control and freedom" usually refers to the user being able to undo and redo their actions(Bascur et.al.,2021). However, I changed the description of this heuristic to the following:

"The user on the website should have control over their content and they should have the ability to customize their items postings. They should be able to edit and remove their posts and any mistakes."

Secondhand e-commerce allows users to be both sellers and buyers, meaning they are responsible for the majority of the content on the website and the interaction. Therefore, it is important that they have more control over certain functionalities of the website, such as adding, deleting and updating their item postings.

The majority of the updated heuristics were changed because of the unique features of secondhand e-commerce and the needs of its users.

And at last, I will answer my main research question:

How do heuristics that evaluate user experience of secondhand e-commerce look like?

The following are **13 heuristics** for evaluation secondhand e-commerce, that undergone validation test of heuristic evaluation and were proven efficient in detecting usability issues:

1. Consistency and standards,
2. Attractive elements,
3. Personalized user experience,
4. Flexibility and efficiency of use,
5. Reliability, speed and security of website and transactions,
6. Payment methods,
7. Visibility of system status and feedback,
8. Correctness, visibility, and validity of the information,
9. Accurate and detailed results,
10. Recognition rather than recall,
11. User control and freedom,
12. Help, contact and documentation,
13. Customer feedback.

Discussion

Future work

This Master Thesis provides a good starting ground for further development of heuristics for secondhand e-commerce. Researchers could use this paper for their literature review stage of heuristics development methodology. Even though these heuristics were created for secondhand e-commerce, there are many aspects which cover generic e-commerce as well. Therefore, I believe that they could also be used for further development of generic e-commerce after adapting the descriptions and checklist of heuristics. Furthermore, these heuristics could also serve as an evaluation of an early design solutions for secondhand e-commerce. By implementing recommendations gathered from the interviews it could be a good starting point for building a new platform.

Limitations

Development of heuristics is a long and elaborate process. I chose the methodology by Quiñones et.al. (2018), which attempts to provide an organized way of developing heuristics. Since most ways of developing new heuristics depend on literature review, heuristics are very much affected by researchers' access to the information. Even though there was a very limited amount of information available regarding secondhand e-commerce and e-commerce heuristics in general, I believe that my Master Thesis would benefit from having access to more databases and scientific articles. However, since I am a student, I was not able to gain access to some valuable resources.

The final result of my Master thesis, the secondhand e-commerce heuristics were also affected by the interview. I only interviewed 6 people, due to the lack of time and resources and there was a lack of variety of interviewees. I believe that my research could benefit from more diverse participants, when it comes to age and gender. As I only interviewed woman under 30 as those were people who I was able to persuade to participate in an interview. Also choosing people who have experience shopping secondhand online made it difficult to find male participants. Having more people for interviews could provide more features for survey evaluation. This would potentially create new heuristics or provide features that would find the old heuristics, which were removed in my case, suitable.

Bibliography

1. Bader, F., Schön, E. M., & Thomaschewski, J. (2017). Heuristics considering ux and quality criteria for heuristics. International Journal of Interactive Multimedia and Artificial Intelligence, 4(6), 48. https://doi.org/10.9781/ijimai.2017.05.001
2. Bascur, Camila & Rusu, Cristian & Quiñones Otey, Daniela. (2021). ECUXH: A Set of User eXperience Heuristics for e-Commerce. 10.1007/978-3-030-77626-8_27.
3. Majid, N. Kamaruddin and Z. Mansor, "Adaptation of usability principles in responsive web design technique for e-commerce development," 2015 International Conference on Electrical Engineering and Informatics (ICEEI), 2015, pp. 726-729, doi: 10.1109/ICEEI.2015.7352593.
4. Bonastre, L., & Granollers, T. (March 23-27, 2014). A Set Of Heuristics for User Experience Evaluation in E-commerce Websites. ACHI 2014 : The Seventh International Conference on Advances in Computer-Human Interactions, Barcelona, Spain
5. Bryman, A. (2012). Social research methods (4th ed). Oxford University Press.(p.1-77,p.97-128,p.183-208,p.416-429,p.469-499)
6. Cao, M., Zhang, Q., & Seydel, J. (2005). B2C e-commerce web site quality: An empirical examination. Industrial Management & Data Systems, 105(5), 645–661.
7. Chammas, A., Quaresma, M., & Mont'Alvão, C. (2015). A closer look on the user centred design. Procedia Manufacturing, 3, 5397–5404. https://doi.org/10.1016/j.promfg.2015.07.656
8. Creswell, J.W. (2003). Selection of a research design (Chapter 1) in Research design: Qualitative, quantitative, and mixed methods approaches. (2nd ed.)
9. Cronin, P., Ryan, F., & Coughlan, M. (2008): Undertaking A Literature Review: A Step-By-Step Approach. British Journal of Nursing, 17(1), 38–43.
10. Díaz, J., Rusu, C., & Collazos, C. A. (2017). Experimental validation of a set of cultural-oriented usability heuristics: E-Commerce websites evaluation. *Computer Standards & Interfaces*, *50*, 160–178. https://doi.org/10.1016/j.csi.2016.09.013
11. Fabien, D., Lova, R., Caroline, B., Aurélie, D. (2016). How to Explain Infatuation with the Online Secondhand Market? An Analysis of Motivations and Perceived Risks. In: Groza, M., Ragland, C. (eds) Marketing Challenges in a Turbulent Business Environment. Developments in Marketing Science: Proceedings of the Academy of Marketing Science. Springer, Cham. https://doi.org/10.1007/978-3-319-19428-8_74
12. Fang, X., & Salvendy, G. (2003). Customer-centered rules for design of e-commerce Web sites. *Communications of the ACM*, *46*(12), 332–336. https://doi.org/10.1145/953460.953518
13. Gonzalez-Holland, E., Whitmer, D., Moralez, L., & Mouloua, M. (2017). Examination of the Use of Nielsen's 10 Usability Heuristics & Outlooks for the Future. Proceedings of the Human Factors and Ergonomics Society Annual Meeting, 61(1), 1472–1475. https://doi.org/10.1177/1541931213601853
14. Goodman, E., Kuniavsky, M. & Moed, A. (2012). Observing the user experience: a practitioner's guide to user research (2nd ed). (p. 73 - 92, p.327-376,p.479-530) Morgan Kaufmann.
15. Goodwin, K. (2009). Chapter 11: Personas in Designing for the digital age: How to create human-centered products and services. Wiley Pub.(p.229-297)
16. Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? : An experiment with data saturation and variability. Field Methods, 18(1), 59–82. https://doi.org/10.1177/1525822X05279903

17. Guiot, D., & Roux, D. (2010). A second-hand shoppers' motivation scale: Antecedents, consequences, and implications for retailers. Journal of Retailing, 86(4), 355–371.
18. Hamid, Soomaiya & Bawany, Narmeen & Zahoor, Kanwal. (2020). Assessing Ecommerce Websites: Usability and Accessibility Study. 10.1109/ICACSIS51025.2020.9263162.
19. Hasan, L., Morris, A., & Probets, S. (2012). A comparison of usability evaluation methods for evaluating e-commerce websites. Behaviour & Information Technology, 31(7), 707–737. https://doi.org/10.1080/0144929X.2011.596996
20. How COVID-19 triggered the digital and e-commerce turning point. (March, 2021). UNCTAD. Retrieved May 14, 2022, from https://unctad.org/news/how-covid-19-triggered-digital-and-e-commerce-turning-point
21. Hur, E. (2020). Rebirth fashion: Secondhand clothing consumption values and perceived risks. *Journal of Cleaner Production*, *273*, 122951. https://doi.org/10.1016/j.jclepro.2020.122951
22. Ingaldi, M., & Ulewicz, R. (2019). How to make e-commerce more successful by use of kano's model to assess customer satisfaction in terms of sustainable development. Sustainability, 11(18), 4830. https://doi.org/10.3390/su11184830
23. ISO 9241-210:2019(en). Ergonomics of human-system interaction — Part 210: Human-centred design for interactive systems
24. Jach, Katarzyna & Kuliński, M. (2012). Heuristic Evaluation for e-commerce web pages usability assessment. 460-471.
25. Jastram, S. M., & Schneider, A.-M. (Eds.). (2018). Sustainable fashion: Governance and new management approaches. Springer International Publishing. https://doi.org/10.1007/978-3-319-74367-7
26. Jepsen, A. L., & Eskerod, P. (2009). Stakeholder analysis in projects: Challenges in using current guidelines in the real world. International Journal of Project Management, 27(4), 335–343. https://doi.org/10.1016/j.ijproman.2008.04.002
27. Joshi, A., Kale, S., Chandel, S., & Pal, D. (2015). Likert scale: Explored and explained. British Journal of Applied Science & Technology, 7(4), 396–403. https://doi.org/10.9734/BJAST/2015/14975
28. Kim, J., & Lee, J. (2002). Critical design factors for successful e-commerce systems. Behaviour & Information Technology, 21(3), 185–199. https://doi.org/10.1080/0144929021000009054
29. Kvale, S., & Brinkmann, S. (2009). InterViews: Learning the craft of qualitative research interviewing (2nd ed). Sage Publications.(p.1-24, 25-51, 55-75, 83-100)
30. Laudon, K. C., & Traver, C. G. (2017). E-commerce 2017: Business, technology, society (Thirteenth Edition). Pearson.(p.1-44,p.172-222)
31. Lazar, J., Feng, J. H., & Hochheiser, H. (2017). Research methods in human-computer interaction (Second edition). Elsevier, Morgan Kaufmann Publishers.(p.105-133, p.187-228,p.299-327)
32. *Lukas Peters(2021).Top Fashion online stores worldwide in 2021. (n.d.). Statista. Retrieved May 14, 2022, from https://www.statista.com/forecasts/860718/top-online-stores-global-fashion-ecommercedb*
33. Mackenzie, Noella & Knipe, Sally. (2006). Research dilemmas: Paradigms, methods and methodology. Issues in Educational Research. 16. 193-205.
34. Maguire, Martin (2001). Methods to support human-centred design. Int. J. Hum.-Comput. Stud. 55, 4 (October 2001), p.587–634.
35. Maioli, L. (2018). Fixing bad ux designs : Master proven approaches, tools, and techniques to make your user experience great again. Packt Publishing, Limited. (p.1-20,21-60)
36. Mangiaracina R., Brugnoli G., Perego A. (2009). The eCommerce Customer Journey: A Model to Assess and Compare the User Experience of the eCommerce Websites. 14.

37. Manning, Jimmie. (2017). In Vivo Coding. 10.1002/9781118901731.iecrm0270.
38. Matzler, K., Hinterhuber, H. H., Bailom, F., & Sauerwein, E. (1996). How to delight your customers. Journal of Product & Brand Management, 5(2), 6–18. https://doi.org/10.1108/10610429610119469
39. Meiselwitz, G. H. (Ed.). (2021). Social computing and social media: 13th International Conference, SCSM 2021, held as part of the 23rd HCI International Conference, HCII 2021, virtual event, July 24-29, 2021: proceedings. Part 1: Experience design and social network analysis. Springer. p.407-420
40. Mendelow, A.L. (1981). Environmental Scanning-The Impact of the Stakeholder Concept. ICIS.
41. Miaskiewicz, T., & Kozar, K.A. (2011). Personas and user-centered design: How can personas benefit product design processes? Design Studies, 32, 417-430.
42. Mu, C. (2021). Application of User Research in E-commerce App Design. In: Nah, F.FH., Siau, K. (eds) HCI in Business, Government and Organizations. HCII 2021. Lecture Notes in Computer Science(), vol 12783. Springer, Cham. https://doi-org.zorac.aub.aau.dk/10.1007/978-3-030-77750-0_8 p.120-130
43. Nemat, R. (2012). "Taking a look at different types of e-commerce "in TI Journals. World Applied Programming., vol. 1, no. 2, pp. 100– 104
44. *Nielsen, J. (1994). Enhancing the explanatory power of usability heuristics. Proceedings of the SIGCHI Conference on Human Factors in Computing Systems Celebrating Interdependence - CHI '94, 152–158. https://doi.org/10.1145/191666.191729*
45. Nielsen, J. (1994). Interactive technologies: Usability engineering. Elsevier Science & Technology Books Ebrary
46. Nielsen, J. (2006). How to Conduct a Heuristic Evaluation.
47. Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., & Gwilt, A. (2020). The environmental price of fast fashion. *Nature Reviews Earth & Environment*, *1*(4), 189–200. https://doi.org/10.1038/s43017-020-0039-9
48. Ogonowski, P. (2019, August 15). Nielsen Heuristics and How to Implement them in Ecommerce.https://www.growcode.com/blog/how-to-use-nielsen-heuristics-in-ecommerce/
49. *Peter Morville. (2004, June 21)User experience design. Semantic Studios. https://semanticstudios.com/user_experience_design/*
50. Pickard, A. J. (2013). "Major Research Paradigms" (Chapter 1) In: Research Methods in Information. 2nd Ed. London: Facet Publishing
51. Pruitt, J., & Grudin, J. (2003). Personas: Practice and theory. Proceedings of the 2003 Conference on Designing for User Experiences - DUX '03, 1. https://doi.org/10.1145/997078.997089
52. Quiñones Otey, Daniela & Rusu, Cristian & Roncagliolo, Silvana & Rusu, Virginica & Collazos, César. (2016). Formalizing the Process of Usability Heuristics Development. 10.1007/978-3-319-32467-8_113.
53. Quiñones, D., & Rusu, C. (2019). Applying a methodology to develop user eXperience heuristics. *Computer Standards & Interfaces*, *66*, 103345. https://doi.org/10.1016/j.csi.2019.04.004
54. Quiñones, D., Rusu, C., & Rusu, V. (2018). A methodology to develop usability/user experience heuristics. Computer Standards & Interfaces, 59, 109–129. https://doi.org/10.1016/j.csi.2018.03.002
55. Rattanawicha, P. "Information Quality of e-Commerce Websites%3a Changes of Expectation and Satisfaction over Time." *Proceedings of the International Conference on Electronic Business %28ICEB%29* 2014-January (2014): 140–149. Print.

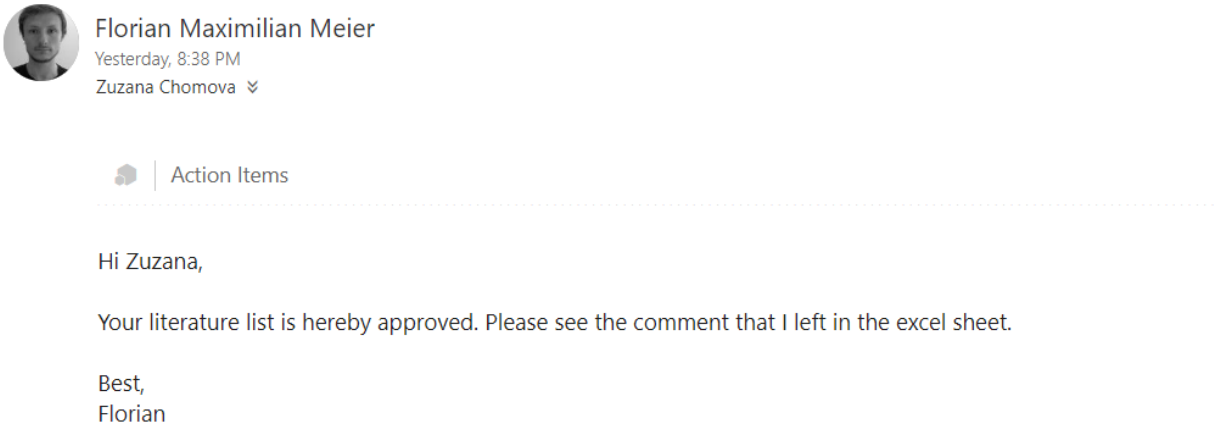
56. *Reasons for cart abandonment – why 68% of users abandon their cart (2022 data) – articles*. (n.d.). Baymard Institute. Retrieved May 11, 2022, from https://baymard.com/blog/ecommerce-checkout-usability-report-and-benchmark
57. Ritter, M., & Winterbottom, C. (2017). UX for the Web: Build websites for user experience and usability.(p.7-24, p. 95-122)
58. Roto, V., Obrist, M., & Väänänen-Vainio-Mattila, K. (2009). User Experience Evaluation Methods in Academic and Industrial Contexts.
59. Rowley, J., & Slack, F. (2013). Conducting a Literature Review. Management Research News, 27(6), 31–39.
60. Rusu, C., Roncagliolo, S., Rusu, V., & Collazos, C. (23-28/2, 2011). A methodology to establish usability heuristics. Paper presented at the ACHI 2011 - 4th International Conference on Advances in Computer-Human Interactions, Gosier, Guadeloupe, France (p.59-62)
61. Saetang, S. (2017). The E-Commerce strategies responding to the UX design. 2017 10th International Conference on Ubi-Media Computing and Workshops (Ubi-Media), 1–6. https://doi.org/10.1109/UMEDIA.2017.8074086
62. Sartzetaki, Maria & Psaromiligkos, Yannis & Retalis, Symeon & Avgeriou, Paris. (2004). An approach for usability evaluation of e-commerce sites based on design patterns and heuristics criteria.
63. Scacca S.(2020, November 10) *Best practices for e-commerce ui design*. Smashing Magazine. https://www.smashingmagazine.com/2020/11/best-practices-ecommerce-ui-design/
64. Schrepp, M., Hinderks, A., & Thomaschewski, J. (2017). Construction of a benchmark for the user experience questionnaire(Ueq). International Journal of Interactive Multimedia and Artificial Intelligence, 4(4), 40. https://doi.org/10.9781/ijimai.2017.445
65. Shen, D., Richards, J., & Liu, F. (2013). Consumers' awareness of sustainable fashion. Marketing Management Journal, 23(2), p.134-147
66. Sohn, J., Nielsen, K. S., Birkved, M., Joanes, T., & Gwozdz, W. (2021). The environmental impacts of clothing: Evidence from United States and three European countries. Sustainable Production and Consumption, 27, 2153–2164. https://doi.org/10.1016/j.spc.2021.05.013
67. Sommerville, I. (2010). Requirements Engineering (chapter 4). In Software Engineering. London: Pearson.
68. Sood, A., Khanna, S., Gupta, R., & Singh, A. (2018). Analysing, designing, implementation and coding e-commerce through ux. In I. Woungang & S. K. Dhurandher (Eds.), International Conference on Wireless, Intelligent, and Distributed Environment for Communication (Vol. 18, pp. 69–107). Springer International Publishing. https://doi.org/10.1007/978-3-319-75626-4_6
69. Styvén Maria & Mariani Marcello. (2020). Understanding the intention to buy secondhand clothing on sharing economy platforms: The influence of sustainability, distance from the consumption system, and economic motivations. Psychology & Marketing. 37. 10.1002/mar.21334.
70. Sudiana, Y. U. Chandra and L. Angela, "Key Success Factors for a Better User Experience in E-Commerce Website," 2021 International Conference on Information Management and Technology (ICIMTech), 2021, pp. 512-516, doi: 10.1109/ICIMTech53080.2021.9535076.
71. Tan, W., Liu, D., & Bishu, R. (2009). Web evaluation: Heuristic evaluation vs. user testing. International Journal of Industrial Ergonomics, 39(4), 621–627. https://doi.org/10.1016/j.ergon.2008.02.012
72. T. Zhou and S. Zhang, "Examining the Effect of E-commerce Website Quality on User Satisfaction," 2009 Second International Symposium on Electronic Commerce and Security, 2009, pp. 418-421, doi: 10.1109/ISECS.2009.24.

73. Thabang Excellent Mofokeng (2021) An empirical study stepping towards ethnographic research for e-commerce websites: A perspective of user-centered design, African Journal of Science, Technology, Innovation and Development, DOI: 10.1080/20421338.2021.1958987
74. Tharindu, Pathagama Kuruppuge & Koggalage, R. (2021). Usability of E-Commerce Websites: State of the Art and Future Directions. 3. 314-319. 10.5281/zenodo.4529411.
75. Thoma, V., Williams, B. (2009). Developing and Validating Personas in e-Commerce: A Heuristic Approach. In: , et al. Human-Computer Interaction – INTERACT 2009. INTERACT 2009. Lecture Notes in Computer Science, vol 5727. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-03658-3_56
76. Tucker, R. (2021, January 21). Virtual vintage: How secondhand stores are staying pandemic-proof by going online. The Globe and Mail. https://www.theglobeandmail.com/life/style/article-virtual-vintage-how-secondhand-stores-are-staying-pandemic-proof-by/
77. Vagias, Wade M. (2006). Likert-type scale response anchors. Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management. Clemson University
78. Varvasovszky, Zsuzsa & Brugha, Ruairi. (2000). Stakeholder analysis. Health policy and planning. 15. 338-45. 10.1093/heapol/15.3.338.
79. Visconti, L. M., Peñaloza, L., & Toulouse, N. (Eds.). (2013). Marketing management (0 ed.). Routledge. https://doi.org/10.4324/9780203357262
80. Wilson, C. (2014). User interface inspection methods: A user-centered design method. Elsevier. https://doi.org/10.1016/C2012-0-06519-2 (p.1-48)
81. Wilson, C. (Ed.). (2010). User experience re-mastered: Your guide to getting the right design. Morgan Kaufmann Publishers. (p.1-22,p.23-71,p.345-357)
82. Zheng, H., & Chen, L. (2020). Affecting factors of consumers' purchase decision on sustainable fashion clothing products. 2020 IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), p.873–877. https://doi.org/10.1109/IEEM45057.2020.9309765

Appendix 1

Images:

Image 1: Literature approval



Florian Maximilian Meier
Yesterday, 8:38 PM
Zuzana Chomova

Action Items

Hi Zuzana,

Your literature list is hereby approved. Please see the comment that I left in the excel sheet.

Best,
Florian

Documents:

Document 1: Interview script

Type: semi-structured interview
The purpose: to understand a second-hand shopping customer and what things are important to them when shopping
The goal: better understanding of the customer + user-based heuristics elicitation

Official guide:

First, I would like to say thank you for taking your time and having this interview with me. This interview will help me with my master thesis which focuses on designing an online secondhand. The interview should take approximately half an hour.
As mentioned before, the audio of this call will be recorded for educational purposes and will be deleted within a few weeks, is that okay with you?
I would like to mention that you are allowed to refrain from answering the questions and you can withdraw your consent at any time during the interview.

Buying secondhand items

Have you ever purchased secondhand items?
What is your motivation/ reason for buying secondhand items?
Where do you buy secondhand items?
Do you ever buy secondhand items online? Have you tried any secondhand apps or websites?
What was your experience with these apps/ websites?
What is the most important information for you when buying a secondhand item online?
Did you experience any frustrations when shopping secondhand online?
Was there any information that is important to you which was missing?
Are there any features or possibilities you wish these platforms would provide?
Did you ever have issues with these apps/ websites?
Have you ever experienced issues with the purchases you made through these platforms?

Selling secondhand items

Have you ever tried selling/sold your items through secondhand website or application?
If yes – which platforms, did you try and could you please tell us about the experience?
Is there anything you wish any of these platforms you tried would offer? Any features or services?
If you could imagine a perfect online secondhand web-shop, what would it look like?

Document 2: Survey

Here is a link where you can access the survey: https://forms.gle/bYu4wWiFnLLUz3cV6

Tables:

Table 1: Information regarding secondhand e-commerce prioritized

Value	Information type	Description	Value justification
3	Definition of e-commerce	Definition and classification of different types of e-commerce by Nemat(2011)	Describes types of e-commerce in more detail than Tharindu(2021)
2	Definition of e-commerce	Definition of e-commerce websites and their usability by Tharindu(2021)	Provides shorter description with less detail than Nemat(2011).
3	Definition of secondhand	Visconti et.al.(2013)	Provides understanding of the business type of the chosen domain.
3	Online secondhand shopping motivators	Online secondhand markets, motivators and risks by Fabien et.al.(2016)	Provides understanding of motivator in buying and selling secondhand online.
3	Online secondhand shopping intentions	Intentions to buy secondhand clothing on c2c platform by Styvén & Mariani(2020)	Provides understanding of intentions to buy secondhand on c2c platform.
3	Definition of e-commerce	In depth definition and classification of different types of e-commerce by Ritter & Winterbottom (2017)	Provides deep understanding of e-commerce
2	Secondhand shopping motivators	Secondhand clothing shopping motivators and risks by Hur (2020)	Focuses on physical secondhand, studies by Fabien et.al()2016 and Styvén & Mariani (2020) are more domain specific.
2	Secondhand shopping motivators	Secondhand shopper's motivation study by Guiot & Roux(2010)	Focuses on physical secondhand, studies by Fabien et.al()2016 and Styvén & Mariani (2020) are more domain specific.

Table 2: Information regarding secondhand e-commerce features prioritized

Value	Information type	Description	Value justification
3	Features of secondhand e-commerce	Competitor analysis performed on 5 businesses on the market by me	Analysis provides features of current solutions that customers use.
3	Features of secondhand e-commerce	Analyzed interviews of 6 different people who purchase secondhand online at different platforms.	Interview analysis provides features that users appreciate, that are important to them and the features that they are missing in the solution they use.
2	Features of e-commerce	Fang & Salvendy (2003) described 19 most important design features of e-commerce	These are general features/ design rules that every e-commerce should follow but they are less elaborate then Bonastre & Granollers(2014).
2	Design factors of e-commerce	Kim & Lee (2002) described design factors that affect e-commerce quality	This study focuses a lot on just the information quality regarding the product and therefore was not selected as it is not broad enough.
3	e-commerce heuristics	64 e-commerce heuristics by Bonastre & Granollers (2014)	Even though these are heuristics, they are more of a checklist for functionality and features that e-commerce should contain in general.

Table 3: Features of secondhand e-commerce prioritized (based on the survey)

Value	Description
3	**The website should offer a filter for size.**
3	**The website should offer a filter for price range.**
3	**The website should provide a filter for color.**
3	**The website should provide filters for types of material.**
3	**The website should provide a filter for condition.**
2	The website should provide a filter based on styles.
3	**The website should provide a filter for the brand.**
2	The website should provide an option to filter based on the measurements.
3	**The website should provide sections based on item type**

2	The website should provide sections based on style
1	The website should provide sections based on season
2	The website should provide “similar items” section on the product’s page.
2	The website should display a “recommended items” section.
2	The website should display a “popular items” section.
3	**The website should provide save to favorites function.**
3	**The website should store favorites even without logging in.**
3	**The website should store shopping carts even without logging in.**
3	**The B2C website should provide a place to read and leave reviews of the company with a place for customers to upload the images of their received items.**
3	**The B2C website should provide information about the location it is shipping from.**
3	**The C2C website should provide a filter for location/distance from the seller.**
3	**The person on c2c website should be able to place an item with a bidding option for a price.**
3	**The website should provide a chat function so the buyer can contact the seller with inquiries.**
3	**The website should provide reviews of the seller.**
3	**The website should provide reviews of the buyer.**
3	**The seller should be able to review the buyer**
3	**The buyer should be able to review the seller.**
3	**The c2c website should display other items that the seller is selling.**
3	**The c2c website should provide a profile for seller and buyer so users can see who they buy items from.**
3	**The seller should not be able to contact the buyer without the buyer contacting first.**
2	The seller should be notified about people saving the item into favorites.
3	**The website should provide information about the size of the item based on the label.**
3	**The website should provide information about the condition of the item.**
3	**The website should provide information about the material of the item where possible.**
3	**The website should provide a picture of the item label where possible.**
3	**The website should provide information about the color of the item.**
2	The website should provide the original price of the item if possible.
3	**The website should provide the price of the item.**
1	The website should display how many people are looking at the item you are browsing.

1	The website should display how many people are interested in the item (wishlist count.)
3	**The website should only allow upload of unedited images of the items.**
2	The B2C website should provide the measurements of the item
3	**The website should provide images of the item on a figurine or a model.**
3	**The website should provide good quality images of the items.**

Table 4: UX and usability attributes prioritized

Value	Information type	Description	Value justification
2	UX attributes	5 attributes that are evaluated by heuristics by Bader et.al. (2017)	These attributes are based on what heuristics usually evaluate.
3	Ux attributes	7 attributes by Morville(2004)	These heuristics are generally applicable to user experience.
2	Usability attributes	5 attributes for responsive design by Majid et. Al. (2015)	Attributes specific to responsive design solutions.
3	Usability attributes	5 attributes by Nielsen(1994)	General usability attributes.

Table 5: Existing e-commerce heuristics evaluated

Value	Information type	Description	Details	Justification
2	e-commerce heuristics guidelines	30 guidelines by Hamid et. Al. (2020)	Nielsen's 10 heuristics adapted in e-commerce evaluation by Hamid et. Al. (2020)	Not a set of heuristics, just guidelines for implementing Nielsen's heuristic in e-commerce.
2	e-commerce heuristics guidelines	41 guidelines by Ogonowski(2019)	Ogonowski provided another way to apply Nielsen's heuristics in e-commerce	Nielsen's heuristics' adaptation in e-commerce.
2	e-commerce heuristics	64 e-commerce heuristics	Bonastre & Granollers (2014) generic e-commerce heuristics	First study that attempted generalization of e-commerce heuristics, however they are more of a checklist of features.
3	e-commerce heuristics	11 e-commerce heuristics	Bascur et al. (2021) e-commerce heuristic based on literature review	General e-commerce heuristics including validation and following the same methodology.

2	e-commerce heuristics	23 e-commerce heuristics	Cao et. Al. (2005) 23 heuristics to evaluate information quality of e-commerce websites	Focuses mainly on information quality and not user experience in general.
3	e-commerce heuristics	12 culturally focused e-commerce heuristics	Díaz et.al.(2017) proposed 12 heuristics for e-commerce website.	E-commerce heuristics based on similar methodology including validation.

Table 6: Evaluating Bonastre & Granollers (2014) separately

value	feature/recommendation	
3	The navigation should be obvious enough through the related sections.	This was not covered by a survey or competitor analysis and is an important aspect of a good e-commerce structure.
3	Does the website use a clear user-logical hierarchy of categories to classify products and to find them?	This adds a higher level to sectioning evaluated by survey.
2	Do Category Pages include appropriate filters or facets by features?	These filters are better covered by features from the survey.
3	Does the website provide a search box to locate products and information?	This was not covered by a survey or competitor analysis and is an important feature of good e-commerce.
3	Does the search have advanced features that allow for a limit to a great variety of criteria (features, categories, etc.)?	This was not covered by a survey or competitor analysis and is an important feature of good e-commerce.
3	Does the search engine provide the customer's expected results?	This was not covered by a survey or competitor analysis and is an important feature of good e-commerce.
3	Are there appropriate mechanisms, such as filters or facets to refine the search results?	Filters were only covered by competitors' analysis and survey on products page and therefore filters for search specification were marked as important.
3	Do the pages and sub-pages provide orientation elements? - (breadcrumbs, titles, subtitles)	This was not covered by a survey or competitor analysis and is an important aspect of a good e-commerce structure.
3	Does the checkout process include a progress indicator at the top of the checkout pages?	This was not covered by a survey or competitor analysis and is an important aspect of a good e-commerce structure.

3	Does the website clearly display the "call to action buttons”?	This was not covered by a survey or competitor analysis and is an important aspect of a good e-commerce structure.
2	Does the website include a site map?	This was already covered by visible site hierarchy and was marked as less important.
3	Does the website use elements to draw the customer's attention?	This was not covered by a survey or competitor analysis and is an important feature of e-commerce structure when it comes to gaining customers.
3	Are the new products or special offers prominently advertised?	This is also important in the increase of sales and was marked as important.
3	Does the website show the number of current visitors?	This is also important in the increase of sales and was marked as important.
2	Is the information about the products accurate, informative, and convincing?	This was marked as important as it builds the customer's trust, however it is covered by specific features from survey already.
2	Does the website provide value-added information and services?	This concern, as explained by the authors, is related to sections on the pages which were covered in the survey.
3	Is the website content regularly updated?	This was marked as important as it builds the customer's trust.
3	Is the content based on the users' needs?	This was marked as important as it is crucial in user-centered e-commerce.
2	Are there multimedia resources to explain the products?	This is an important feature; however, it was already covered by the survey.
1	Is there any indicator about the product availability as soon as possible in the purchasing process?	Not applicable for secondhand items since there is always just one item of each kind.
2	Is there enough information that relates to products or services?	Product information was covered by the survey and therefore prioritized over this feature.
2	Are there product-related ratings and reviews?	Ratings and reviews were covered by the survey and therefore prioritized over this feature.
1	Is there a mechanism for the customer to indicate the usefulness of other customers reviews?	This is usually relevant when there are multiple items of the same kind and is not applicable in secondhand e-commerce.

2	Are customers allowed to comment in other customers' reviews?	This feature was evaluated as more important when there is multiple of the same product and was therefore not considered highly important.
1	Does the website include product reviews published by the media?	Not applicable for secondhand since there is always just one item of each kind.
3	Are there tools to ease the comparison between different products?	This is an important feature for choosing the right item since there can be many similar items secondhand and were chosen as important.
3	Are the order charges, such as taxes and shipping costs specified as soon as possible in the purchasing process?	This is an important aspect which was not covered by a survey or competitor analysis.
3	Is there any information about the delivery dates?	This is an important aspect which was not covered by a survey or competitor analysis.
1	Does the website provide recommended products?	“Recommended items” was evaluated by the survey as not an important feature.
1	Does the website provide products related to the selected product?	“Similar items” was evaluated by the survey as not an important feature.
3	Does the website have a shopping cart which is accessible from all the pages?	This is an important aspect which was not covered by a survey or competitor analysis.
3	Does the website incorporate a Wishlist?	This was evaluated by a survey as important – having a favorites(wishlist).
2	Are there Intelligent Agents that can assist the customer?	This is an important part of offering help to the customer, however the functions provided by chat seemed more important as the items are unique.
3	Is there enough information to assist in the purchase process, ex. form fields placeholders?	This is an important aspect which was not covered by a survey or competitor analysis
3	Is the checkout process divided into logical steps?	This is an important aspect which was not covered by a survey or competitor analysis
3	If registration is required, is the process short and simple and does it demand only essential information?	This is an important aspect which was not covered by a survey or competitor analysis

2	Are there enough alternatives for the delivery of the order?	When it comes to sustainability, sometimes there are limited amounts of delivery options.
3	Does the website allow for enough payment options?	This is an important aspect which was not covered by a survey or competitor analysis
3	Are the different costs and discounts applied in the order and detailed before it is approved?	This is an important aspect which was not covered by a survey or competitor analysis
3	Is the button to confirm the purchase clearly visible?	This is an important aspect which was not covered by a survey or competitor analysis
2	Does the website provide different means for completing the order?	This was not selected as important since the number of products is too big, and the stock sells out fast.
3	Does the website show security logos?	This is an important aspect which was not covered by a survey or competitor analysis.
3	Does the website inform of the level of security when paying by credit card?	This is an important aspect which was not covered by a survey or competitor analysis
3	Does the system send a confirmation email after the customer's order?	This is an important aspect which was not covered by a survey or competitor analysis
3	Is it possible to track the status of an order from the customer account?	This is an important aspect which was not covered by a survey or competitor analysis
3	Can the customers manage their order(s) from the customer account?	This is an important aspect which was not covered by a survey or competitor analysis
2	Does the website allow the customer to return an item?	This is an important quality of e-commerce, but it was not considered a feature.
3	Is the response time of the website reasonable?	This is an important aspect which was not covered by a survey or competitor analysis
3	Is the waiting time for the search results reasonable?	This is an important aspect which was not covered by a survey or competitor analysis
3	Is the interface's style consistent?	This is an important aspect which was not covered by a survey or competitor analysis
2	Does the website present an innovative and attractive image?	The attractivity and innovativeness of the website was already described by the features and concistency.

2	Is the website exciting?	This was not considered as a motivating factor and was marked as less important.
3	Does the website personalize any type of contact with the customer?	This is an important aspect which was not covered by a survey or competitor analysis
1	Does the website offer the possibility for the customer to become a VIP?	The exclusivity has not been shown as a motivated factor in literature for shopping secondhand and is therefore not relevant.
3	If personal information is required by the website, does it have the Privacy Policy available?	This is an important aspect which was not covered by a survey or competitor analysis
3	Does the website have safety certificates granted by external companies?	This is an important aspect of customer safety which was not covered by a survey or competitor analysis
3	Is contact information visible during the purchase process?	This is an important aspect which was not covered by a survey or competitor analysis
3	Does the website provide different means for customers to contact the company?	This is an important aspect which was not covered by a survey or competitor analysis
3	Is the best way to contact the company clarified for each type of concern?	This is an important aspect which was not covered by a survey or competitor analysis
3	Does the website give the address of the company?	This is an important help for customers which was not covered by a survey or competitor analysis
3	Does the website have a FAQ section that covers common customer questions?	This is an important help for customers which was not covered by a survey or competitor analysis
2	Does the company respond to comments and concerns expressed by the customers?	This was not considered as a feature but more of a practice and was therefore not selected.
2	Is the appearance of the website safe and reliable?	This is an important feature for customers' trust; however, it is not a specific feature and was therefore not selected.

Table 7: Heuristics definition

ID	SEH1
Priority	3
Name	Consistency and standards

Description	The user interface of the website should be consistent in terms of style and structure and it should follow e-commerce standards.
Violation example	Different style buttons for the same function.
UX/usability benefits	Following this heuristic helps the website be more usable and credible.
Problems of misconception	The consistency of the user interface and following of the standards for e-commerce websites does not mean that the interface cannot be creative and use attractive and innovative features.
Checklist	• Is the design of the website consistent throughout all pages? • Are all buttons visible, consistent, and following a standard? • Is the confirm order button visible in the checkout process? • Is the website structure visible and following a standard for e-commerce websites? • Does the website contain orientation elements, such as breadcrumbs, titles and subtitles? • Is the website responsive?

ID	SEH2
Priority	2
Name	Attractive elements
Description	The website should include attractive elements which will catch the user's attention and make the website more attractive and memorable.
Violation example	Multiple offer design tags on the same product.
UX/usability benefits	Following attractive elements heuristic can make website more desirable.
Problems of misconception	Attractive elements should serve the user and be based on their needs. They should not be pushing advertisements and put pressure on the customer.
Checklist	• Does the website clearly display newly added products? • Does the website advertise deals, promotions and offers? • Does the website use visual elements such as banners? • Does the website show the number of visitors?

ID	SEH3
Priority	3
Name	Personalized user experience
Description	The website needs to provide a possibility for the user to create an account and when user is logged in, the website should adapt to the user's needs. This helps the user create a relationship with the website. It also provides a secure community where users can see each other and know who they are buying from.
Violation example	User account icon on the right corner is missing username under the icon, when user is logged in.

UX/usability benefits	Following this heuristic helps website be more desirable, useful and credible.
Problems of misconception	This should not be understood as targeted advertisement of the customer.
Checklist	• Does the website provide an option for sellers to create an account? • Does the website provide an option for buyers to create an account? • Does the website change user icon name and greetings based on the customer's account? • Does the website use customer's name and information in the emails? • Is the content and displayed products based on the customer's information and preferences? • Can customers save product to a favorite list or wishlist?

ID	SEH4
Priority	3
Name	Flexibility and efficiency of use
Description	The website must be designed so it is efficient to use for any user, new customer, or frequent shopper. It should help customers navigate through the website and find the items they are looking for.
Violation example	The website does not provide logical sectioning of the items.
UX/usability benefits	By following this heuristic website is more efficient and usable for customers.
Problems of misconception	The website should still maintain a logical structure while striving to be as efficient as possible.
Checklist	Does website provide sections based on item type? Does website should contain a search box? Does search functionality contain advanced features that specify search criteria? Does website provide filters or facets to refine search results? Is registration simple and only requires essential information? Does website provide sorting functionality for the items? Does website provide a filter for color? Does website offer a filter for size? Does website offer a filter for price range? Does website provide filters for types of material? Does website provide a filter for the brand? Does website provide a filter based on the item category? Does website should provide a filter for condition? Does website store wishlist even without logging in? Does website contain tools for comparison between products? Does C2C website provide a filter for location/distance from the seller? Does website allow order tracking from the customer's account? Does website allow management of the orders from the customer account?

ID	SEH5
Priority	3
Name	Reliability, speed and security of website and transactions
Description	The transactions performed on the website should be secure and provide reliability measures. The websites should work within reasonable response time and provide a secure environment for shoppers.
Violation example	The website does not provide security certificates during checkout.
UX/usability benefits	By following this heuristic, the website is more credible and efficient.
Problems of misconception	By following security measures of the website incorrectly, customers will be forced to choose another e-commerce solution.
Checklist	Does website display security logos? Are website's response time and waiting time reasonable? Does website inform of the security level when paying with a credit card? Does the website contain certificates granted by external companies? Does website provide space for discount codes in the checkout process?

ID	SEH6
Priority	3
Name	Payment methods
Description	The website should offer multiple types of payment methods for the customer to finish their purchase.
Violation example	The website only offers one type of payment method such as paypal, and no other means.
UX/usability benefits	Implementation of this heuristic helps website be more credible and useful.
Problems of misconception	The website should have multiple payment options, but it doesn't have to cover all possible payment types, such as the ones that are not usually accessible in the country of e-commerce. This might make the website seem less credible.
Checklist	• Does the website offer more than one type of payment type? • If payment by credit card, does the website offer multiple choices for credit card brand?

ID	SEH7
Priority	3
Name	Visibility of system status and feedback
Description	The user should be informed about their shopping process on the website and feedback from the interface should be provided.
Violation example	The checkout process does not have a displayed progress bar.
UX/usability benefits	Implementation of this heuristic makes website more usable and efficient.
Problems of misconception	The misconception of heuristic can cause a user to be confused rather than help them orientate themselves through the website.

Checklist	• Is the checkout process divided into logical steps? • Does design display user's position in the checkout process by providing status bar or similar? • Does website send a confirmation message after customers' order? • Does the cart show the number of items in it? • Does the wishlist provide feedback?

ID	SEH8
Priority	3
Name	Correctness, visibility and validity of the information
Description	All the important information for the customers should be clearly visible, correct and valid. The information should also be specified as soon as possible in the purchasing process.
Violation example	The shipping costs are not showed before the payment.
UX/usability benefits	Following this heuristic can make the website more credible and useful.
Problems of misconception	The misunderstanding of this heuristic and wrong implementation can cause confusion for the users and make them feel overwhelmed.
Checklist	• Does website contain only relevant, not outdated content? • Does website provide information about the size of the item based on the label? • Does website should provide information about the condition of the item? • Does website provide information about the material of the item where possible? • Does website provide a picture of the item label where possible? • Does website provide information about the color of the item? • Does website provide the price of the item? • Does website only allow upload of unedited images of the items? • Does website provide images of the item on a figurine or a model? • Does website provide good quality images of the items? • Are shipping costs and order charges specified in the purchasing process as soon as possible? • Does website provide visible information about the delivery date? • Does the website should provide information about the location it is shipping from? (b2c website) • Is the contact information visible during the purchasing process? • Does website display other items that the seller is selling?

ID	SEH9
Priority	3
Name	Accurate and detailed results
Description	The website's search functionality should provide accurate and detailed results relevant to the search term and they should be displayed in a concise way.
Violation example	The search returns irrelevant results.
UX/usability benefits	Following this heuristic can make the website more efficient for the user.
Problems of misconception	Misconception of this heuristic can worsen the orientation of the customer on the website and their ability to find what they need.
Checklist	• Does the search return relevant results? • Are search results providing enough information? • Are search results displayed in a clear and comprehensive way?

ID	SEH10
Priority	3
Name	Recognition rather than recall
Description	The website should make it as easy as possible to orientate themselves through the website and make the purchases without having to remember too much information.
Violation example	The website does not provide examples in the input fields.
UX/usability benefits	Following this heuristic makes the website more efficient and usable.
Problems of misconception	The misconception of this heuristic can make it more difficult for users to make purchases on the website.
Checklist	Does the website contain examples in the form fields to help with the purchase process? Does the website provide an option to store customer information? Does the website have a shopping cart accessible from all pages?

ID	SEH11
Priority	3
Name	User control and freedom
Description	The user on the website should have control over their content and they should have the ability to customize their items postings. They should be able to edit and remove their posts and any mistakes.
Violation example	The user is not able to delete their post.
UX/usability benefits	This heuristic provides value for the customer and makes the website more usable.
Problems of misconception	Even though websites should give user freedom there should still be limitations set based on the website's functionality and purpose.
Checklist	• Can the seller delete their posts? • Can the seller update their posts?

	• Are there multiple categories and fields for sellers to better describe the items they are posting for sale? • Can a person on c2c website place an item with a bidding option for a price? • Is the seller not able to contact the buyer without the buyer making the first contact?

ID	SEH12
Priority	3
Name	Help, contact and documentation
Description	The website should always provide a way for customers to get help with anything regarding the website or the purchase, it should provide the documentation for users to understand the process better and there should always be a way of contacting the company.
Violation example	The company does not provide contact information.
UX/usability benefits	Implementing this heuristic can make website more useful, credible and valuable for the user.
Problems of misconception	The misunderstanding of this heuristic can provide confusing and unhelpful information for the customers when they need help.
Checklist	Does website provide chat to assist customers when they need help? Does website have a visible privacy policy when personal information is required? Does the website have a visible shipping, return, and exchange policy? Does website provide different means of contacting the company? Does the website clearly display the address of the company? Does the website provide FAQ section? Does website provide a chat function so the buyer can contact the seller with inquiries?

ID	SEH13
Priority	3
Name	Customer feedback
Description	The customer should be able to leave feedback for sellers, buyers and the company so the other users can make a more informed decision when purchasing items.
Violation example	The website does not provide reviews of the seller.
UX/usability benefits	Following this heuristic makes the website more credible and valuable for the user.
Problems of misconception	The wrong way of implementing this heuristic can cause users to be more confused about the product and the sellers.
Checklist	Does B2C website provide a place to read and leave reviews of the company with a place for customers to upload the images of their received items? Does the website should provide reviews of the seller? Does the website provide reviews of the buyer? Is the seller able to review the buyer?

	Is the buyer able to review the seller?

Table 8: Heuristic evaluation results

Veras Vintage

Heuristic items		Severity					Example
		Cosmetic	Minor	Major	Catastrophic	Total	
SEH1	Consistency and standards			1		1	The website did not provide breadcrumbs on their pages, and there were no orientation elements.
SEH2	Attractive elements		1			1	The website did not show the number of visitors.
SEH3	Personalized user experience			3		3	The user icon did not contain any name or user indicator.
SEH4	Flexibility and efficiency of use		1	4	1	6	The add to wishlist heart function was clickable but unfunctional when not logged in, without any error response.
SEH5	Reliability, speed and security of website and transactions		1	2		3	The website's response time was slow and there was no loader giving feedback about it.
SEH6	Payment methods					0	
SEH7	Visibility of system status and feedback		1	4		5	The wishlist did not display the number of items in it, in the icon.
SEH8	Correctness, visibility and validity of the information		2	2		4	The website contained outdated content, such as items which are sold and not available anymore.
SEH9	Accurate and detailed results			1		1	The search for dress, return also shirt and jackets and other items not relevant to the category.

SEH10	Recognition rather than recall					0	
SEH11	User control and freedom				1	1	The user password is not possible to change from user profile.
SEH12	Help, contact and documentation			3		3	The website does not provide visible privacy policy, when private information are required.
SEH13	Customer feedback			1		1	The website does not have any reviews on the website, nor it provides the space for customers to leave feedback.

Trensales

Heuristic items		Severity					Example
		Cosmetic	Minor	Major	Catastrophic	Total	
SEH1	Consistency and standards					0	
SEH2	Attractive elements		2			2	The website does not clearly display newly added items.
SEH3	Personalized user experience			1		1	The website does not use personalized greetings in emails.
SEH4	Flexibility and efficiency of use		2	1			The website does not store wishlist without logging in.
SEH5	Reliability, speed and security of website and transactions					0	
SEH6	Payment methods					0	
SEH7	Visibility of system status and feedback			2		2	The wishlist icon doesn't display the number of items in wishlist.

SEH8	Correctness, visibility and validity of the information			2		2	The website allows upload of edited images of items and screenshots.
SEH9	Accurate and detailed results					0	
SEH10	Recognition rather than recall					0	
SEH11	User control and freedom		1	1	1	3	The user password is not possible to change from user profile.
SEH12	Help, contact and documentation			3		3	The website does not display the address of the company.
SEH13	Customer feedback					0	